Volume 01

Galena Park High School Phase 3A - New Fieldhouse

GPISD Project #: 002.3-2025

CSP#: 25-500

GALENA PARK INDEPENDENT SCHOOL DISTRICT

GPISD
FACILITY PLANNING
AND CONSTRUCTION

Proposal Checklist

Project:	Galena Park High School Phase 3A
Project #:	002.3-2025
Total Project Budget:	$15,000,000.00
Pre-Proposal Conference:	Galena Park ISD Administration Building 14705 Woodforest Blvd, Houston, TX 77015 June 24, 2025 at 10:00 AM Attendance is highly recommended.
Proposal Opening Location:	Galena Park ISD Administration Building 14705 Woodforest Blvd, Houston, TX 77015
Proposal Deadline:	July 15, 2025 at 2:00 PM

Items Due 5 Days Prior to Proposal Opening – July 8, 2025

Pre-Proposal Information (See attribute 6 for additional information)

- ☐ OSHA (Occupational Safety & Health Administration) inspection logs for the last 3 years, a loss analysis from the Offeror's insurance carrier, & a loss history covering all lines of insurance coverage carried by the Offeror.
- ☐ Qualification Statement (AIA Document A305).
- ☐ A list of at least five (5) projects of similar scope as the project being proposed of which have been completed in the last five (5) years.
- ☐ Contractor's Proposed Project Personnel.

Items Due at Bid Time – July 15, 2025 at 2:00 PM

Bid Package including:

- ☐ Bid Bond/Proposal Bond (10%)
- ☐ Response to Sections 1 - 20
- ☐ Respond to All Bid Lines
- ☐ Respond to All Alternate Bid Lines
- ☐ Unit Prices
- ☐ Subcontractor Listing
- ☐ Small Business Enterprise Program (SBEP)
- ☐ Contractor Information

Bid Attachments

- ☐ Request for Taxpayer Identification Number and Certification W9
- ☐ Conflict of Interest Questionnaire
- ☐ Certificate of Interested Parties Form 1295
- ☐ State and Federal Certification Forms
- ☐ Certification of Criminal History Record Information

Contract Documents [provided for Proposal Preparation, does not need to be submitted with proposal]

Table of Contents

Base Proposal **27 Pages**

Base Proposal Information Page 1
Proposal Attributes Page 3

1. Introduction
2. Submission Response
3. Communications Statement
4. Attachments Required
5. Proposal Opening
6. Submission Required PRIOR to Proposal Opening
7. Instructions to Proposers for Contracts for Construction
8. Project Information
9. Proposal Acknowledgement
10. Proposal Bond for Building Construction Contracts
11. Proposal Phase Procedures
12. Felony Conviction Notice
13. Affidavit of Non-Collusion
14. Certificate of Residency
15. Verification of Business Type
16. Conflict of Interest Questionnaire
17. Contractor's Proposed Project Personnel
18. Antitrust Certification Statement
19. Form 1295 – Certificate of Interested Parties
20. Contract Documents Deviations and Exceptions

Proposal Lines **Page 25**
Alternate Proposal Lines **Page 5**
Unit Prices **Page 8**
Subcontractor Listing Page 20
Small Business Enterprise Program Page 26
Contractor Information Page 27

Base Bid Attachments **28 Pages**

Request for Taxpayer Identification Number and Certification
Conflict of Interest Questionnaire
Certificate of Interested Parties Form 1295
State and Federal Certification Form
Certification of Criminal History Record Information

Sample Construction Documents **31 Pages**

Standard form of Agreement between Owner and Contractor for Building Construction Contracts
Instructions for Performance and Payment Bonds
General Conditions of the Contract for Construction
Supplementary Conditions to the General Conditions of the Contract for Construction
Special Conditions of the Contract for Construction

Base Proposal Information

CSP #	25-500
Project:	Galena Park High School Phase 3A - New Fieldhouse
Type:	Competitive Sealed Proposal
Issue Date:	June 15, 2025
Question Deadline:	July 7, 2025 @ 10:00 AM
Response Deadline:	July 9, 2025

25-500 **PROPOSAL** Close Date and Time: July 15, 2025 @ 2:00 PM

Galena Park Independent School District (GPISD) is requesting **Competitive Sealed Proposals (CSP 25-500)** for Galena Park High School Phase 3A **(GPISD Project B104-002.3-2025**. **Proposals are due on July 15, 2025 at 2:00 PM (Base & Alt at same time)** after which proposals will be opened publicly and read aloud at the GPISD Administration Building. Submissions must be delivered to the **Facility Planning & Construction Department** in the GPISD Administration Building, 14705 Woodforest Blvd., Houston, TX 77015, in a sealed envelope by the close date and time stated in this bid event. A Proposal Security in the amount of ten percent (10%) of the proposal amount is required.

The scope of work includes: Approximate Built up area 34,000 SF, two-story Field House including site works

A pre-proposal conference will be held at the **GPISD Administration Building**, on June 24, 2025 at 10:00 AM. Attendance is highly recommended.

Proposal Documents will be available on June 15, 2025 @ 10:00 AM on the district website, and on the GPISD eBid system https://galenaparkisd.ionwave.net.

GPISD reserves the right to reject any and all proposals, the right to negotiate with any proposers after submission of proposals, and at its discretion, may waive any formalities or minor irregularities regarding the proposals.

Ship To Information

Address: Facilities Planning and Construction Department
Galena Park ISD Administration Building
14705 Woodforest Blvd.
Houston, TX 77015
Phone: (832) 386-1020
Email: facilities@galenaparkisd.com

Billing Information

Address: Accounts Payable
Galena Park ISD Administration Building
14705 Woodforest Blvd.
Houston, TX 77015
Phone: (832) 386-1025
Fax: (832) 386-1428
Email: accounts_payable@galenaparkisd.com

Activities

Pre-Proposal Conference	June 24, 2025 at 10:00AM
Response to Questions Due	July 9, 2025
Board of Trustee Meeting	August 11, 2025
Contract Execution	August 8, 2025
Owner Receives Bonds and Insurance	August 18, 2025
Notice to Proceed	August 25, 2025
Substantial Completion	June 10, 2026
Final Completion	June 6, 2027

Proposal Attributes

1. Introduction
There are attributes, including this one, associated with this proposal. Some are notes and require no response, but most have a required response.

2. Submission Response
Please ensure that you respond to all Proposal Attributes and Line Items. Manual submissions must be delivered to the Facilities Planning and Construction Department, in a sealed envelope by the close date and time stated in this Proposal event. No fax or email submissions will be accepted. Manual submission shall consist of one (1) original hard copy and one (1) electronic flash drive. For any questions, please contact the Facilities Planning and Construction Department at facilities@galenaparkisd.com.

3. Communications Statement
Contact between vendors and Galena Park ISD personnel during the proposal process or evaluation process is prohibited. Any attempt by vendors during the proposal process to contact district personnel may result in disqualification. All communication shall go through the Facilities Planning and Construction Department during this competitive process. All questions received and the corresponding answers will be distributed to all Proposers. No verbal responses will be provided. The deadline for questions about this proposal is stated in the Proposal Activities and the district will not respond to questions after this time and date. Response to questions will be posted in the ebid system and on Addenda. The vendors will be responsible for checking the ebid system for any posted responses.

4. Attachments Required
Be sure to submit all required documents and forms.

5. Proposal Opening
Any proposal received later than the specified time, whether delivered in person or by any other method shall be disqualified. Any questions pertaining to the proposal procedures should be addressed to the Facilities Planning and Construction Department at facilities@galenaparkisd.com. If the District office location where proposals are to be submitted is closed due to inclement weather, natural disaster, or for any other cause including if the electronic Proposal system is unavailable on the due date, the deadline for submission shall be extended until the next District business day, unless the Proposer is otherwise notified by the District. The time of day for submission shall remain the same.

6. Submission Required PRIOR to Proposal Opening
The following forms are required **5 days prior to the proposal opening**:

- OSHA (Occupational Safety and Health Administration) inspection logs for the last three years, a loss analysis from the Proposer's insurance carrier, and a loss history covering all lines of insurance coverage carried by the Proposer.
- Qualification Statement (AIA Document A305).
- A list of at least five (5) projects of similar scope as the project being proposed of which have been completed in the last five (5) years.
- Contractor's Proposed Project Personnel.

Proposer Qualification Statements are the primary vehicle used by the project evaluation members to assess the credentials of the Proposer with respect to evaluation criteria set forth in the Project Manual leading to the recommendation for award of Contract.

In order to receive full consideration during the proposal evaluation period, each Proposer must submit a completed Qualification Statement (AIA Document A305) to the Architect and Owner.

Forms should be submitted to **BOTH** the Architect/Engineer at **gloria.carlos@PBK.com** and to the GPISD Facilities Department at **facilities@galenaparkisd.com**

7. Instructions to Proposers for Contracts for Construction

ARTICLE 1. DEFINITIONS

1.0 Definitions set forth in the GPISD General Conditions of the Contract for Construction, or in other Proposal Documents, are applicable to the Proposal Documents.

1.1 Proposal Documents: Advertisement for Competitive Sealed Proposals, Instructions to Proposers, Proposal Security, Proposal Form, Felony Conviction Notice, Affidavit of Non-collusion, Certificate of Residency, the Drawings and the Project Manual.

1.2 Sub-proposer: A person or entity who submits a proposal to a Proposer for materials, equipment or labor for a portion of the Work.

1.3 Addenda: Written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Proposal Documents by additions, deletions, clarifications or corrections.

1.4 Proposal: A complete and properly signed Proposal to do the Work for the sums stipulated therein, submitted in accordance with the Proposal Documents.

1.5 Base Proposal: The sum stated in the Proposal for which the Proposer offers to perform the Work described in the Proposal Documents as the Base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Proposals.

1.6 Alternate Proposal (or Alternate): An amount stated in the Proposal to be added to, or deducted from, the amount of the Base Proposal if the corresponding change in the Work, as described in the Proposal, is accepted by the Owner.

1.7 Unit Price: An amount stated in the Proposal as a price per unit of measurement to add or delete for labor, materials, and equipment or services or a portion of the Work as described in the Proposal Documents.

1.8 Proposer: A person or entity who submits a Proposal. Proposer, contractor, and General Contractor shall have the same meaning and be interchangeable.

1.9 Safety Record: A proposer's OSHA (Occupational Safety and Health Administration) inspection logs for the last three years, a loss analysis from the Proposer's insurance carrier, and a loss history covering all lines of insurance coverage carried by the proposer.

1.10 Architect/Engineer: the term determines that architect/engineer shall have the same meaning and be interchangeable.

1.11 Bid Bond/Proposal Bond/Proposal Security: shall have the same meaning and be interchangeable.

ARTICLE 2. PROPOSER'S REPRESENTATIONS

2.1 The Proposer by making a Proposal represents that:

2.1.1 The Proposer has read and understands the Proposal Documents and the Proposal is made in accordance therewith.

2.1.2 The Proposer has visited the site; has become familiar with local conditions under which the Work is to be performed; and has correlated the Proposer's personal observations with the requirements of the Proposal Documents.

2.1.3 The Proposal is based upon the materials, equipment and systems required by the Proposal Contract Documents without exception.

ARTICLE 3. PROPOSAL DOCUMENTS

3.1 Copies

3.1.1 Proposers may obtain complete sets of the Proposal Documents from the issuing office designated in the Advertisement for Sealed Proposals in the number and for the deposit sum, if any, stated therein. The deposit will be refunded to Proposers who return the Documents to the issuing office in good condition and in good order within ten days after proposal opening. The cost of replacement of missing or damaged Documents will be deducted from the deposit. A Proposer receiving a Contract award may retain the Documents and the Proposer's deposit will be refunded.

3.1.2 Proposal Documents will not be issued for deposit directly to Sub-proposers or others unless specifically offered in the Advertisement for Sealed Proposals, or in the Instructions to Proposers.

3.1.3 Additional complete sets of Proposal Documents, if available, may be obtained by Proposers and Sub- proposers from the issuing office for the cost of reproduction and mailing, which costs are not refundable. It shall be understood by entities obtaining additional sets and paying the reproduction and mailing costs that such additional sets remain the Owner's exclusive property and shall be returned to the office from where the Proposal Documents were issued.

3.1.4 Proposal Documents will also be issued to plan rooms in those cities which are likely to be home locations of Proposers and Sub-proposers.

3.1.5 Proposers shall use complete sets of Proposal Documents in preparing Proposals; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Proposal Documents.

3.1.6 In making copies of the Proposal Documents available on the above terms, the Owner and the Architect do so only for the purpose of obtaining Proposals on the Work; and do not confer a license or grant permission for any other use of the Proposal Documents.

3.2 Interpretation or Correction of Proposal Documents

3.2.1 The Proposer shall carefully study and compare the Proposal Documents with each other, and with other work being proposed concurrently or presently under construction to the extent that it relates to the Work for which the Proposal is submitted; shall examine the site and local conditions; and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.

3.2.2 Proposers and Sub-proposers requiring clarification or interpretation of the Proposal Documents shall make a written request which shall reach the Architect at least 10 working days prior to the date for receipt of Proposals.

3.2.3 Interpretations, corrections and changes of the Proposal Documents will be made by addendum. Interpretations, corrections and changes of the Proposal Documents made in any other manner will not be binding, and Proposers shall not rely upon them.

3.3 Substitutions

3.3.1 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.

3.3.2 No substitution will be considered prior to receipt of Proposals unless a written request for approval has been received by the Architect at least ten days prior to the date for receipt of Proposals. 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 substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work (including changes in the work of other contracts that incorporation of the proposed substitution would require) shall be included. The burden of proof of the merit of the proposed substitution is upon the Proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

3.3.3 If the Architect approves a proposed substitution prior to receipt of Proposals, such approval will be set forth in an Addendum. Proposers shall not rely upon approvals made in any other manner.

3.3.4 No substitutions will be considered after the Contract award unless specifically provided for in the Proposal Documents.

3.4 Addenda

3.4.1 Addenda will be mailed, faxed or Contractor shall pick up to those known by the issuing office to have received a complete set of Proposal Documents.

3.4.2 Copies of Addenda will be made available for inspection wherever Proposal Documents are on file for that purpose.

3.4.3 Each Proposer shall ascertain prior to submitting a Proposal that the Proposer has received all Addenda issued; and the Proposer shall acknowledge their receipt on the Proposal Form.

3.4.4 Additional complete sets of Proposal Documents, if available, may be obtained by Proposers and Sub- proposers from the issuing office for the cost of reproduction and mailing, which costs are not refundable. It shall be understood by entities obtaining additional sets and paying the reproduction and mailing costs that such additional sets remain the Owner's exclusive property and shall be returned to the office from where the Proposal Documents were issued.

3.4.5 Proposal Documents will also be issued to plan rooms in those cities which are likely to be home locations of Proposers and Sub-proposers.

3.4.6 Proposers shall use complete sets of Proposal Documents in preparing Proposals; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Proposal Documents.

3.4.7 In making copies of the Proposal Documents available on the above terms, the Owner and the Architect do so only for the purpose of obtaining Proposals on the Work; and do not confer a license or grant permission for any other use of the Proposal Documents.

3.5 Interpretation or Correction of Proposal Documents

3.5.1 The Proposer shall carefully study and compare the Proposal Documents with each other, and with other work being proposed concurrently or presently under construction to the extent that it relates to the Work for which the Proposal is submitted; shall examine the site and local conditions; and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.

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3.6.4 No substitutions will be considered after the Contract award unless specifically provided for in the Proposal Documents.

3.7 Addenda

3.7.1 Addenda will be mailed, faxed or Contractor shall pick up to those known by the issuing office to have received a complete set of Proposal Documents.

3.7.2 Copies of Addenda will be made available for inspection wherever Proposal Documents are on file for that purpose.

3.7.3 Each Proposer shall ascertain prior to submitting a Proposal that the Proposer has received all Addenda issued; and the Proposer shall acknowledge their receipt on the Proposal Form.

ARTICLE 4. PROPOSAL PROCEDURES

4.1 Form and Style of Proposals

4.1.1 Proposals shall be submitted on forms included with the Proposal Documents.

4.1.2 All blanks on the Proposal Form shall be filled in electronically or manually in ink.

4.1.3 Where so indicated by the makeup of the Proposal Form, sums shall be expressed in both words and figures, and in cases of discrepancy between the two, the amount written in words shall govern.

4.1.4 Interlineations, alterations and erasures must be initialed by the signer of the Proposal.

4.1.5 All requested Alternates shall be proposed. If no change in the Base Proposal is required, enter "No Change."

4.1.6 Where two or more Proposals for designated portions of the Work have been requested, the Proposer may, without forfeiture of the proposal security, state the Proposer's refusal to accept award of less than the combination of Proposals stipulated by the Proposer. The Proposer shall make no additional stipulations on the Proposal Form nor qualify the Proposal in any other manner.

4.1.7 Each copy of the Proposal shall include the legal name of the Proposer and a statement that the Proposer is a sole proprietor, partnership, corporation or other legal entity. Each copy shall be signed by the person or persons legally authorized to bind the Proposer to a contract. A Proposal by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Proposal submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Proposer.

4.1.8 To be considered complete, the Proposal shall include the following attributes, line items and/or forms completely and accurately filled out and executed:

- Proposal (including Unit Prices and Alternate Proposals if applicable)
- Proposal Bond - 10%
- Felony Conviction Notice
- Affidavit of Non-Collusion
- Certificate of Residency
- Verification of Business Type
- Conflict of Interest Questionnaire
- Contractor's Proposed Project Personnel
- Antitrust Certification Statement
- Form 1295 – Certificate of Interested Parties
- Contract Documents Deviations and Exceptions
- Request for Taxpayer Identification Number and Certification (W9_
- Conflict of Interest Questionnaire (form)
- Certificate of Interested Parties Form 1295 (form)
- State and Federal Certification Form
- Certification of Criminal History Record Information
- Subcontractor Listing

4.1.9 For additional proposal information and requirements refer to the following:

Proposal Phase Procedures
Contractor Proposed Project Personnel

4.2 Proposal Bond and Insurance

4.2.1 If so stipulated in the Advertisement for Sealed Proposals, or the Instructions to Proposers, each Proposal shall be accompanied by a Proposal Security in the form and amount required, pledging that the Proposer will enter into a Contract with the Owner on the terms stated in the Proposal and will, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Proposer refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the Proposal Security shall be forfeited to the Owner as liquidated damages, not as a penalty.

4.2.2 If a Proposal Bond is required it may be written on the Owner's standard form, a copy of which is included with the Proposal Documents, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney.

4.2.3 The Owner will have the right to retain the Proposal Security of Proposers to whom an award is being considered until either (a) the Contract has been executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Proposals may be withdrawn, or (c) all Proposals have been rejected.

4.2.4 The Proposer shall provide the required insurance prior to the issuing of the Notice to Proceed. Should the Proposer fail to furnish such Insurance, the amount of the Proposal Security shall be forfeited to the Owner as liquidated damages, not as a penalty.

4.3 Submission of Proposals

4.3.1 All copies of the Proposal, the Proposal Security, if any, and other documents required to be submitted with the Proposal shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Proposals and shall be identified with the Project Name, the Owner's Project Number, the Proposer's name and address and if applicable, the designated portion of the Work for which the Proposal is submitted, If the Proposal is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED PROPOSAL ENCLOSED" on the face thereof.

4.3.2 Proposals shall be deposited at the designated location prior to the time and date for receipt of Proposals. Proposals received after the time and date for receipt of Proposals will be returned unopened.

4.3.3 The Proposer shall assume full responsibility for timely delivery at the location designated for receipt of Proposals.

4.3.4 Oral, telephonic, telegraphic Proposals or revisions noted on the outside of the sealed opaque envelope are invalid and will not receive consideration.

4.4 Modification or Withdrawal of Proposal.

4.4.1 A Proposal may not be modified, withdrawn or canceled by the Proposer for a period of sixty (60) calendar days following the time and date designated for the receipt of Proposals, and each Proposer so agrees in submitting a Proposal.

4.4.2 Prior to the time and date designated for receipt of Proposals, a Proposal submitted may be modified or withdrawn by notice to the party receiving Proposals at the place designated for receipt of Proposals. Such notice shall be in writing over the signature of the Proposer or by telegram. If by telegram, written confirmation over the signature of the Proposer shall be mailed and postmarked on or before the date and time set for receipt of Proposals. A change shall be so worded as not to reveal the amount of the original Proposal.

4.4.3 Withdrawn Proposals may be resubmitted up to the date and time designated for the receipt of Proposals provided that they are then fully in conformance with these Instructions to Proposers.

4.4.4 Proposal Security, if required, shall be in an amount sufficient for the Proposal as modified or resubmitted.

ARTICLE 5. PRE & POST PROPOSAL INFORMATION

5.1 Submittals

5.1.1 Upon request by the Owner, Proposers shall provide the following:
.1 a designation of the Work to be performed with the Proposer's own forces;
.2 names of the manufacturers, products and the suppliers of principal items or systems of materials and equipment proposed for the Work; and

.3 names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

5.1.2 The Proposer will be required to establish to the satisfaction of the Architect and the Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Proposal Documents.

5.1.3 Prior to the award of the Contract, the Architect will notify the Proposer in writing if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Proposer. If the Owner or Architect has reasonable objection to a proposed person or entity, the Proposer may at the Proposer's option (1) withdraw the Proposal, or (2) submit an acceptable substitute person or entity with an adjustment in the Base Proposal or Alternate Proposal to cover the difference in cost occasioned by such substitution. The Owner may accept the adjusted proposal price or disqualify the Proposer. In the event of either withdrawal or disqualification, Proposal Security will not be forfeited.

5.1.4 Persons and entities proposed by the Proposer, and to whom the Owner and Architect have made no reasonable objection, must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

ARTICLE 6. CONSIDERATION OF PROPOSALS

6.1 Opening of Proposals

6.1.1 Unless stated otherwise in the Advertisement for Sealed Proposals, the properly identified Proposals received on time will be opened publicly and will be read aloud. An abstract of the Proposals will be made available to Proposers.

6.2 Rejection of Proposals

6.2.1 The Owner shall have the right to reject any or all Proposals, reject a Proposal not accompanied by a required Proposal Security or by other data required by the Proposal Documents, or reject a Proposal which is in any way incomplete or irregular.

6.3 Acceptance of Proposals (Award)

6.3.1 It is the intent of the Owner to award a Contract to the Proposer deemed to be in the best interests of Galena Park I.S.D. provided the Proposal has been submitted in accordance with the requirements of the Proposal Documents and does not exceed the funds available. The Owner shall have the right to waive informalities or irregularities in a Proposal received and to accept the Proposal which, in the Owner's judgment, is in the Owner's own best interests.

6.3.2 The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Proposal Documents, and to determine the low Proposer on the basis of the sum of the Base Proposal and Alternates accepted.

6.4 The Owner will use the following criteria with respect to evaluating the proposals:

Criteria	Percent
Purchase Price (Line Items)	40
Reputation, quality, and long-term value to the Owner (Warranty) of the Proposer's goods and services, and safety record of the proposer. (Exhibit A, B, C, D & E - A305 and References)	20
Qualifications of the Proposers proposed project team (Proposed Project Personnel Attribute, Qualification Statement, & Exhibit C - A305)	10
Qualifications and reputation of the Proposer's proposed subcontractors (Subcontractor Listing Line Item)	15
Proposed Schedule	10
Small Business Participation Commitment	5

ARTICLE 7. PERFORMANCE AND PAYMENT BONDS

7.1 Bond Requirements

7.1.1 If stipulated in the Proposal Documents, the Proposer shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Proposer's usual sources.

7.1.2 If the furnishing of such bonds is stipulated in the Proposal Documents, the cost shall be included in the Proposal.

7.2 Time of Delivery and Form of Bonds

7.2.1 The Proposer shall deliver the required bonds to the Owner not later than ten days following the date of execution of the Contract.

7.2.2 Unless otherwise provided, the bonds shall be written on the Owner's standard forms for performance and payment bonds, copies of which are included in the Proposal Documents. Both bonds shall be written in the amount of the Contract Sum.

7.2.3 The bonds shall be dated on or after the date of the Contract.

7.2.4 The Proposer 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.

ARTICLE 8. FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

8.1 Form to be used

8.1.1 The Agreement for the Work will be written on the Owner's standard form of agreement, a copy of which is included in the Proposal Documents.

8. PROJECT INFORMATION

Project:	**Galena Park High School Phase 3A - New Fieldhouse**
Project Address:	**1000 Keene St.Galena Park, TX 77547**
Project #:	**B104-002.3-2025**
Total Project Budget:	**$15,000,000.00**
Substantial Completion Date:	**June 10, 2026**
The Architect/Engineer is:	**PBK Architects**
	11 Green Plaza,22nd Floor Houston, TX 77046
Contact Name:	**Gloria Carlos**
Contact Email:	**gloria.carlos@PBK.com**

9. PROPOSAL ACKNOWLEDGEMENT

Having carefully examined the Proposal Documents for the Project and all Addenda thereto, as well as the site of the proposed Work and all the conditions affecting the Work, the undersigned proposes to furnish all labor, materials, services and equipment necessary to complete the entire Work in accordance with the Proposal Documents for the sums submitted on the Proposal Lines tab.

BASE PROPOSAL: The undersigned agrees to perform all work required by the Proposal Documents which is not specifically indicated to be proposed as an Alternate.

ALTERNATE PROPOSALS: If the Owner elects to require increases, decreases or changes in the Work specifically described in the Proposal Documents as Alternates, the undersigned agrees to perform such increases, decreases or changes for the sums stated below. The undersigned also understands that the Owner reserves the right to accept or reject any alternate proposal in the order of its choosing and to suit available funding.

The undersigned further agrees, if awarded the Contract, to complete all work required by the Proposal Documents in the number of calendar days after Notice to Proceed or by the specific date stipulated in the Proposal Documents.

The undersigned further agrees that the Proposal Security, payable to the Board of Trustees of the Galena Park Independent School District, accompanying this proposal is left in escrow with the Chief Finance Officer of the Galena Park Independent School District; that its amount is measure of the liquidated damages which the Owner will sustain by the failure of the undersigned to execute and deliver the above named Agreement and Bonds, and that if the undersigned defaults in executing that Agreement or in furnishing the Performance and Payment Bonds or insurance certificates within the stipulated time period following the written notification of the award of the Contract, then the check shall become the property of the Owner, or the Proposal Bond shall become subject to forfeiture to the Owner.

It is understood that the Owner reserves the right to accept or reject any and all Proposals and to waive formalities or irregularities as it deems to serve its best interests. It is further agreed that this Proposal shall be valid and not withdrawn within a period of sixty (60) days from the date of opening thereof. Withdrawal of Proposal within the stipulated sixty-day period may result in the forfeiture of the Proposal Security.

The work to be performed under this Contract shall be commenced within ten (10) days from the date of the Notice to Proceed issued by the Owner and the Contractor shall achieve Substantial Completion within the time stipulated in the Supplementary Conditions of the Contract, subject to adjustments of this Contract Time as provided elsewhere in the Proposal Documents. The time set forth for completion of the Work is an essential element of the Contract.

10. PROPOSAL BOND FOR BUILDING CONSTRUCTION CONTRACTS

Proposal Bond for Building Construction Contracts

A. Each individual Proposal package submitted must be accompanied by Bid Bond made payable to Owner in an amount of five percent (10%) of the Proposal price (for Proposal bond purposes, the Proposal price shall include the base Proposal, plus all alternates; however, the Contract price shall be as awarded by Galena Park Independent School District). Proposal Bond shall be in the form of a Cashier's Check or a Proposal Bond, duly executed by proposer as principal and having as surety thereon, a corporate surety company duly authorized and admitted to do business in the State of Texas and licensed by the State of Texas to issue such bond, as a guarantee that the proposer will enter into a Contract and execute required Performance and Payment Bonds within ten (10) days of Galena Park Independent School District award of Contract.

B. Each Proposal must be accompanied by information establishing that the agent signing the bond is authorized to write the bond in the amount requested, and if applicable, that reinsurance requirements, have been met, including limits and ratings or other evidence of company solvency.

C. Proposer must demonstrate to Owner that he can secure required bonds, issued by a corporate surety company authorized and admitted to do business in the State of Texas and licensed in the State of Texas to issue such bond, which bonds shall be written in the form contained in the Project Manual without modification.

11. PROPOSAL PHASE PROCEDURES

Proposer Qualification Statements
Conditions of the Contract, Supplementary Conditions and Division 1 Apply to this section.

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section contains procedures to be followed by general contractor proposers and sub-contractors / material suppliers during the proposal phase of the project.

1.2 RELATED WORK

A. All sections of specifications contained in the Project Manual.
B. All drawings issued as Contract Documents
C. All Addenda issued during the proposal phase.

1.3 SUBMITTALS

A. Qualification Statements
B. Project Lists
C. References

1.4 QUALITY ASSURANCE

A. The Proposer's Qualification Statement, including accompanying documents, is the primary tool used in the Competitive Sealed Proposal evaluation process. It is the Proposer's opportunity to demonstrate their strengths and qualifications.
B. It is the Proposer's sole responsibility to provide complete information on all required submittal documents.
C. It is the Proposer's sole responsibility to provide reference information that is current, accurate and viable; in that the references submitted shall respond.
    01 Evaluation requests for reference input shall be distributed to references by fax or email.
    02 No attempt shall be made by the Architect to correct inaccurate information submitted by the Proposer.
    03 Non-responses from Proposer's references shall have a negative impact on the Proposer in the evaluation process.
D. It is the Proposer's sole responsibility to provide Qualification Statement, including accompanying documents in a timely manner to allow ample time for reference inquiries and responses, and other evaluation processes.
    01 No attempt shall be made by the Architect to expedite responses from references submitted by the Proposer.
    02 Non-responses from Proposer's references shall have a negative impact on the Proposer in the evaluation process.

PART 2 – PROCEDURES

2.1 PROPOSER QUALIFICATION STATEMENTS

A. Proposer Qualification Statements are the primary vehicle used by the project evaluation members to assess the credentials of the Proposer with respect to evaluation criteria set forth in the Project Manual leading to the recommendation for award of Contract.
    01 It is the sole responsibility of the Proposer to assure the information provided as reference is accurate, current, useful and verifiable.
B. In order to receive full consideration during the proposal evaluation period, each Proposer

must submit a completed Qualification Statement (AIA Document A305) to the Architect and Owner according to the "Submission Required PRIOR to Proposal Opening" attribute.

01 Qualification Statements received after the "Submission Required PRIOR to Proposal Opening" deadline shall be accepted and processed; however, the proposer shall bear any / all consequences of a less than adequate evaluation due to a late submission.

02 Fax submissions will not be accepted.

C. In addition to the information required in AIA A305 Qualification Statement, each proposer shall submit the following specific information attached to the Qualification Statement:

01 A list of at least five (5) projects of similar scope as the project being proposed on which have been completed in the last five (5) years. Referenced projects to include the following information:

a. Project Name and Location
b. Project Completion Date
c. Final Project Cost
d. Owner's Name and Contact Information (current phone number, fax number, and email address.).
e. Architect's Project Manager Name and Contact Information (current phone number and fax number).

02 A list of at least five (5) references of Owners and five (5) Architects which the proposer has completed work for in the last five (5) years including the following information:

a. Name and Contact Information (current phone number, and email address).

03 A list of all projects completed in the last three (3) years including the following information:

a. Project Name and Location
b. Project Completion Date
c. Final Project Cost
d. Owner's Name and Contact Information (current phone no.).
e. Architect's Project Manager Name and Contact Information (current phone no.).

D. Any other information the Proposer wishes to submit to be used in the evaluation process.

2.2 ELECTRONIC AVAILABILITY OF PROPOSAL DOCUMENTS

A. Proposal documents – drawings, specifications and addenda – shall be posted on the GPISD website at https://www.galenaparkisd.com/departments/purchasing.

B. Proposal documents – drawings, specifications and addenda – shall be posted in the following plan rooms: isqft.com and virtualbx.com

2.3 PROPOSAL PHASE - REQUEST FOR INFORMATION

A. All Requests For Information (RFI) during the Proposal Phase should be made in writing (email preferred). Requests by telephone shall be accepted only at the discretion of the recipient.

B. Proposal RFI's should be made directly to the responsible party/consultant per the project information attribute.

C. All Proposal RFI's shall be responded to in writing by return fax or email only to the original sender.

D. Official changes to the Contract Documents originating from Proposal RFI's shall be issued by Addendum

2.4 ADDENDA

A. All Addenda shall be issued by the Architect/Engineer on record.
B. Generally, each Addendum shall be limited to a single discipline (Architectural, MEP, Civil, Structural, etc.), containing only Contract Document changes relative to that discipline.
C. All Addenda shall be issued and posted to the district website at https://www.galenaparkisd.com/departments/purchasing.

12. FELONY CONVICTION NOTICE

Felony Conviction Notice

State of Texas Legislative Senate Bill No.1, Section 44.034, Notification of Criminal History, Subsection (a), states “A person or business entity that enters into a contract with a school district must give advance notice to the district if the person or an owner or operator of the business entity has been convicted of a felony. The notice must include a general description of the conduct resulting in the conviction of a felony.” Subsection (b) states “A school district may terminate a contract with a person or business entity if the district determines that the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The district must compensate the person or business entity for services performed before the termination of the contract.” Is your firm owned or operated by anyone who has been convicted of a felony?

Subsection (c) states, “This notice is not required of a publicly held corporation.”

- ☐ My firm is publicly held corporation; therefore, this reporting requirement is not applicable.
- ☐ My firm is not owned or operated by anyone who has been convicted of a felony.
- ☐ My firm is owned or operated by the following individual(s) who has/have been convicted of a felony

(Required: Check only one)

Felony Conviction Details

If your firm is owned or operated by anyone who has been convicted of a felony, please list

- name(s)
- date(s) of conviction(s)
- details of the conviction(s)

If not applicable, please enter N/A (not applicable).

13. AFFIDAVIT OF NON-COLLUSION

Anti-Collusion Statement

The undersigned affirms that they are duly authorized to execute this proposal, that this company, corporation, firm, partnership or individual has not prepared this proposal in collusion with any other proposer, and that the contents of this proposal as to prices, terms or conditions of said proposal have not been communicated by the undersigned nor by any employee or agent to any other person engaged in this type of business prior to the official opening of this proposal.

☐ I agree.

14. CERTIFICATE OF RESIDENCY

Certificate of Residency
The State of Texas has passed a law concerning non-resident contractors. This law makes it necessary for the Galena Park Independent School District to determine the residency of its proposers. This law can be found in Vernon's Annotated Civil Statutes as Article 601g, Sections 1 and 2. It reads:

"Section 1 (a) (2) "Non-resident Proposer means a Proposer whose principal place of business is not in this state but excludes a contractor whose ultimate parent company or majority owner has its principal place of business in this state.

"Section 1 (a) (3) "Texas resident Proposer means a Proposer whose principal place of business is in this state and includes a contractor whose ultimate parent company or majority owner has its principal place of business in this state.

“Section 1(b) The state or governmental agency of the state may not award a contract for general construction, improvements, services, or public works projects or purchases of supplies materials or equipment to a non-resident Proposer unless the non-resident's Proposal is lower than the lowest Proposal submitted by a responsible Texas resident Proposer by the same amount that a Texas resident Proposer would be required to underbid a non-resident Proposer to obtain a comparable contract in the state in which the non-resident's principal place of business is located."

Please select one of the following:
(Required: Check only one)

- ☐ My company is a Resident Proposer
- ☐ My company is a Nonresident Proposer

Certificate of Residency

Enter the **city** and **state** of the principal place of business (under Article 601g).

_____

_____

_____

_____

15. VERIFICATION OF BUSINESS TYPE

Verification of Business Type
(Required: Check only one)

- ☐ Sole Proprietor
- ☐ Partnership
- ☐ Corporation (provide state of incorporation)
- ☐ Other (provide detail in next attribute)

Verification of Business Type

Provide state of incorporation or additional details if applicable

16. CONFLICT OF INTEREST QUESTIONNAIRE

Conflict of Interest Questionnaire

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session. Instructions on filling out this form are included in the Proposal invitation.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. See Section176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An
offense under this section is a misdemeanor.

Local government officers:

Board of Trustees & Superintendent of Schools

Name	**Position**
Ramon Garza	President
Linda Clark Sherrard	Vice President
Jose Jimenez	Secretary
Adrian Stephens	Board Trustee
Noe Esparza	Board Trustee
Norma Hernandez	Board Trustee
Amanda Erebia	Board Trustee
Dr. John C. Moore	Superintendent of Schools

Does this vendor have a conflict of interest with Galena Park Independent School District?
(Required: Check only one).

- ☐ Yes
- ☐ No

17. CONTRACTOR'S PROPOSED PROJECT PERSONNEL

Contractor's Proposed Project Personnel
An item of the evaluation criteria used to select the successful general contractor to perform this work is the qualifications of the Contractor's project team proposed to be assigned to this project. Please submit the names of the personnel in the spaces provided.

Principal in Charge

_____

_____

Project Manager

_____

_____

Assistant Project Manager (as applicable)

_____

_____

Construction Superintendent

_____

_____

Assistant Superintendent (as applicable)

_____

_____

18. ANTITRUST CERTIFICATION STATEMENT

Antitrust Certification Statement

Per Tex. Government Code § 2155.005

I affirm under penalty of perjury of the laws of the State of Texas that:

1. I am duly authorized to execute this contract on my own behalf or on behalf of the company, corporation, firm, partnership or individual (Company)
2. In connection with this Proposal, neither I nor any representatives of the Company have violated any provision of the Texas Antitrust laws codified in Tex. Bus. & Comm. Code Chapter 15;
3. In connection with this Proposal, neither I nor any representative of the Company have violated any federal antitrust law; and
4. Neither I nor any representatives of the Company have directly or indirectly communicated any of the contents of this Proposal to a competitor of the Company or any other company, corporation, firm, partnership or individual engaged in the same line of business as the Company.

(Required: Check only one)

- ☐ Agree
- ☐ Do Not Agree

19. FORM 1295 - CERTIFICATE OF INTERESTED PARTIES

Form 1295 - Certificate of Interested Parties

Pursuant HB 1295, the addition of section 2252.908 of the Government Code, all awarded vendors must fill out electronically, with the Texas Ethics Commission's online filing application. www.ethics.state.tx.us.whatsnew/elf_info_form1295.htm

The law states that a governmental entity or state may not enter into certain contracts with a business entity unless the business entity submits a disclosure of interested parties (Form 1295) to the governmental entity or state agency at the time the business entity submits the signed contract to the governmental or state agency. The Texas Ethics Commission has adopted rules requiring the business to file Form 1295 electronically with the Commission.

This form must then be signed and returned, prior to any business transaction.

Please note the following:
Box 2: Please enter Galena Park ISD
Box 3: Please use CSP# 25-500 as the identification number being requested and Galena Park High School Phase 3A as description of goods or services.

Please acknowledge that you have read and understand that the district may not do business with your company without the submittal of this form.

(Required: Check only one)

- ☐ Yes
- ☐ No

20. CONTRACT DOCUMENTS DEVIATIONS OR EXCEPTIONS

Contract Documents (Sample Contract Documents)
The Contract Documents (Sample Contract Documents) are provided, please check if you agree or disagree to the Terms of the Agreement as presented. This is your electronic signature.

(Required)

☐ I have Read and Agree

No Deviations or Exceptions
I certify that there are NO deviations or exceptions from the attached specific terms, conditions, and specifications.

(Required: Check only one)

☐ Agree - No Deviations
☐ Do Not Agree - Please see below

Deviations and Exceptions
If your company intends to deviate from the Specifications listed in the attached documents, all such deviations and exceptions must be listed here, with complete and detailed conditions and information included. The District will consider any deviations or exceptions in its Proposal award decisions. The District reserves the right to accept or reject any proposals based upon any deviations indicated below. If none, please enter N/A (Not Applicable).

Proposal Lines

BASE PROPOSAL

Item Notes: The undersigned agrees to perform all work required by the Proposal Documents which is not specifically indicated to be proposed as an Alternate for the sum of:

1.1 BASE PROPOSAL:	**$ _____**
1.2 Owners Contingency Allowance	**900,000**
1.3 Interior Printed and Custom Painted Graphics Allowance:	**75,000**
1.4 Base Proposal + Contingency Total:	**$ _____**

_____

(Written Total Amount)

Acknowledge Addendum(s)

Acknowledge receipt of Addendum 1 through _____

Alternate Proposal Lines

ALTERNATES PROPOSAL

Note: See the specification to understand the full scope

Alternate No. 1 A: Direct Digital Controls – **Automated Logic Corporation**
(Response required)

$ _____

Alternate No. 2A: Condensing Boilers - **RBI**
(Response required)

$ _____

Alternate No. 2B: Condensing Boilers - **Raypak**
(Response required)

$ _____

Alternate No. 2C: Condensing Boilers – **Patterson - Kelley**
(Response required)

$ _____

Alternate No. 2D: Condensing Boilers - **Camus**
(Response required)

$ _____

Alternate No. 3A: Scroll Water Chillers Air-Cooled – **Trane - Extended Warranty**
(Response required)

$ _____

Alternate No. 3B: Scroll Water Chillers Air-Cooled **– Carrier- Extended Warranty**
(Response required)

$ _____

Alternate No. 3C: Scroll Water Chillers Air-Cooled **– JCI Extended Warranty**
(Response required)

$ _____

Alternate No. 4A: Packaged, Outdoor, Central-Station
Hydronic Air**-Handling Units – Carrier**
(Response required)

$ _____

Alternate No. 4B: Packaged, Outdoor, Central-Station
Hydronic Air-Handling Units – **Trane**
(Response required)

$ _____

Alternate No. 4C: Packaged, Outdoor, Central-Station
Hydronic Air-Handling Units **– JCI *(Response required)***

$ _____

Alternate 4D: 23 74 13.16 – Packaged, Outdoor, Central-Station
Hydronic Air-Handling Units **– Temtrol**
(Response required)

$ _____

Alternate No. 5: Provide metal stud partition assemblies and accessories in lieu of Integrated Interior Assemblies (Section 13 42 75) per guidelines listed below
(Response required)

$ _____

Base Proposal Reduction – Reference Alternate 5 **$** _____

- Item Notes: If there is a discount to the Base Proposal enter the amount here

UNIT PRICES

Note: See the specification to understand the full scope

Unit Price 01: Removal of unsatisfactory soil and replacement with satisfactory soil material.
(Line excluded from response total)

(Response required)

ADD/DELETE: **$** _____

Unit Price 04: Concrete
(Line excluded from response total)

ADD/DELETE: **$** _____

Unit Price 05: Select Fill
(Line excluded from response total)

(Response required)

ADD/DELETE: **$** _____

Unit Price 06: Spread Footing (Add)
(Line excluded from response total)

(Response required)

ADD/DELETE: **$** _____

Unit Price 07: Spread Footing (Deduct)
(Line excluded from response total)

(Response required)

ADD/DELETE:

$ _____

Unit Price 08: Miscellaneous and structural steel
(Line excluded from response total)

(Response required)

ADD/DELETE: **$** _____

SUBCONTRACTOR LISTING

(Line excluded from response total)

Item Notes: One of the evaluation criteria used to select the successful General Contractor is the proposed project team, including sub-contractors to be used for the Work. In order to receive consideration for the award of the Contract, each Proposer must submit a list of sub-contractors proposed be used for the Work.

Recognizing the Proposer may not have firm contractual agreements with sub-contractors immediately following submission of Proposals, an allowance is made to submit two (2) sub-contractors for each trade listed below.

Package Attributes

1. Self-Performed

Will your company be self-performing ALL work.

- ☐ Yes, all work is self-performed
- ☐ No, we will use subcontractors

(Required: Check only one)

Mechanical Primary _____

Mechanical Secondary _____

Electrical Primary _____

Electrical Secondary _____

Plumbing Primary _____

Plumbing Secondary _____

Site Work Primary _____

Site Work Secondary _____

Site Utilities Primary _____

Site Utilities Secondary _____

Concrete Primary _____

Concrete Secondary _____

Masonry Primary _____

Masonry Secondary _____

Steel Fabrication Primary _____

Steel Fabrication Secondary _____

Steel Erection Primary _____

Steel Erection Secondary _____

Dampproofing Primary _____

Dampproofing Secondary _____

Fire Sprinkler Primary _____

Fire Sprinkler Secondary _____

Roofing Primary _____

Roofing Secondary _____

Hollow Metal Primary _____

Hollow Metal Secondary _____

SCPL Doors Primary _____

SCPL Doors Secondary _____

Finish Hardware Primary _____

Finish Hardware Secondary _____

Glass & Glazing Primary _____

Glass & Glazing Secondary _____

Gyp Bd Systems Primary _____

Gyp Bd Systems Secondary _____

Ceramic Tile Primary _____

Ceramic Tile Secondary _____

Flooring Primary _____

Flooring Secondary _____

Painting Primary _____

Painting Secondary _____

Toilet Partitions Primary _____

Toilet Partitions Secondary _____

Toilet Acc's. Primary _____

Toilet Acc's. Secondary _____

Casework Primary _____

Casework Secondary _____

Fire Alarm Primary _____

Fire Alarm Secondary _____

BCMS Primary _____

BCMS Secondary _____

Data / Tech Primary _____

Data / Tech Secondary _____

Security Primary _____

Security Secondary _____

Small Business Enterprise Program (SBEP)

Item Notes: The Small Business Enterprise Program (SBEP) provides increased business opportunities for small businesses to participate in contracting and procurement opportunities with the District. The SBEP is a goal-oriented program, requiring contractors to whom the District awards prime contracts for architectural design services, engineering design services, or construction services valued at $50,000 or greater to use good-faith efforts to utilize small business subconsultants, subcontractors, and suppliers.

To be eligible as a small business under the SBEP, a business shall:

1. Demonstrate that the firm's gross revenues or number of employees averaged over the past three years, inclusive of any affiliates as defined by 13 C.F.R. 121.103, does not exceed the size standards as defined pursuant to Section 3 of the Small Business Act and 13 C.F.R. 121.201.

2. Have or be eligible for one of the following small business certifications:
   a. Port of Houston Authority SBE Certification (not including any location requirement);
   b. Metropolitan Transit Authority of Harris County (METRO) SBE Certification (not including any location requirement);

In eligible procurements, the District may award additional scoring points to a Proposer or proposer based on its SBEP participation. The District may likewise consider a Proposer or proposer's failure to achieve SBEP participation commitments on previous District projects when scoring a subsequent Proposal. Any weighted point values available to a Proposer or proposer related to SBEP participation shall be published with all other weighted selection criteria in the procurement solicitation.

The respondent to this CSP shall list their Small Business prime contact or sub-contract participation goal /commitment percentage (0%-100%) of their total contract.

1. Provide the Small Business prime contract or sub-contract participation goal /commitment percentage (0%-100%).

(Response required)

Participation goal /commitment percentage (0%-100%) _____

Contractor Information

Company Name: _____

Contact Name: _____

Address: _____

_____

Phone: _____

Fax: _____

Email: _____

Contractor Notes:

_____

_____

The undersigned, in submitting this Proposal and endorsement of same, represents that he/she is authorized to obligate his/her Firm, that he/she is an equal opportunity employer and will not discriminate with regard to race, color, religion, sex, national origin, age or disability unrelated to job performance of this Proposal; that he/she will abide by all the policies and procedures of Galena Park ISD; and that he/she has read this entire Proposal package, is aware of the covenants contained herein and will abide by and adhere to the expressed requirements in ALL sections of this Proposal.

Print Name _____ Signature_____

Form **W-9**
(Rev. March 2024)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

Go to *www.irs.gov/FormW9* for instructions and the latest information.

Give form to the requester. Do not send to the IRS.

Before you begin. For guidance related to the purpose of Form W-9, see *Purpose of Form*, below.

Print or type. See ***Specific Instructions*** on page 3.

1 Name of entity/individual. An entry is required. (For a sole proprietor or disregarded entity, enter the owner's name on line 1, and enter the business/disregarded entity's name on line 2.)

2 Business name/disregarded entity name, if different from above.

3a Check the appropriate box for federal tax classification of the entity/individual whose name is entered on line 1. Check only **one** of the following seven boxes.

☐ Individual/sole proprietor ☐ C corporation ☐ S corporation ☐ Partnership ☐ Trust/estate

☐ LLC. Enter the tax classification (C = C corporation, S = S corporation, P = Partnership) . . . . .

Note: Check the "LLC" box above and, in the entry space, enter the appropriate code (C, S, or P) for the tax classification of the LLC, unless it is a disregarded entity. A disregarded entity should instead check the appropriate box for the tax classification of its owner.

☐ Other (see instructions)

3b If on line 3a you checked "Partnership" or "Trust/estate," or checked "LLC" and entered "P" as its tax classification, and you are providing this form to a partnership, trust, or estate in which you have an ownership interest, check this box if you have any foreign partners, owners, or beneficiaries. See instructions . . . . . ☐

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):

Exempt payee code (if any)

Exemption from Foreign Account Tax Compliance Act (FATCA) reporting code (if any)

(Applies to accounts maintained outside the United States.)

5 Address (number, street, and apt. or suite no.). See instructions.

Requester's name and address (optional)

6 City, state, and ZIP code

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN*, later.

Note: If the account is in more than one name, see the instructions for line 1. See also *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number

			–		–				

or

Employer identification number

		–							

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and, generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

Sign Here	**Signature of U.S. person**	**Date**

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to *www.irs.gov/FormW9*.

What's New

Line 3a has been modified to clarify how a disregarded entity completes this line. An LLC that is a disregarded entity should check the appropriate box for the tax classification of its owner. Otherwise, it should check the "LLC" box and enter its appropriate tax classification.

New line 3b has been added to this form. A flow-through entity is required to complete this line to indicate that it has direct or indirect foreign partners, owners, or beneficiaries when it provides the Form W-9 to another flow-through entity in which it has an ownership interest. This change is intended to provide a flow-through entity with information regarding the status of its indirect foreign partners, owners, or beneficiaries, so that it can satisfy any applicable reporting requirements. For example, a partnership that has any indirect foreign partners may be required to complete Schedules K-2 and K-3. See the Partnership Instructions for Schedules K-2 and K-3 (Form 1065).

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS is giving you this form because they

must obtain your correct taxpayer identification number (TIN), which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following.

• Form 1099-INT (interest earned or paid).

• Form 1099-DIV (dividends, including those from stocks or mutual funds).

• Form 1099-MISC (various types of income, prizes, awards, or gross proceeds).

• Form 1099-NEC (nonemployee compensation).

• Form 1099-B (stock or mutual fund sales and certain other transactions by brokers).

• Form 1099-S (proceeds from real estate transactions).

• Form 1099-K (merchant card and third-party network transactions).

• Form 1098 (home mortgage interest), 1098-E (student loan interest), and 1098-T (tuition).

• Form 1099-C (canceled debt).

• Form 1099-A (acquisition or abandonment of secured property).

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

Caution: If you don't return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See *What is backup withholding*, later.

By signing the filled-out form, you:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued);

2. Certify that you are not subject to backup withholding; or

3. Claim exemption from backup withholding if you are a U.S. exempt payee; and

4. Certify to your non-foreign status for purposes of withholding under chapter 3 or 4 of the Code (if applicable); and

5. Certify that FATCA code(s) entered on this form (if any) indicating that you are exempt from the FATCA reporting is correct. See *What Is FATCA Reporting*, later, for further information.

Note: If you are a U.S. person and a requester gives you a form other than Form W-9 to request your TIN, you must use the requester's form if it is substantially similar to this Form W-9.

Definition of a U.S. person. For federal tax purposes, you are considered a U.S. person if you are:

• An individual who is a U.S. citizen or U.S. resident alien;

• A partnership, corporation, company, or association created or organized in the United States or under the laws of the United States;

• An estate (other than a foreign estate); or

• A domestic trust (as defined in Regulations section 301.7701-7).

Establishing U.S. status for purposes of chapter 3 and chapter 4 withholding. Payments made to foreign persons, including certain distributions, allocations of income, or transfers of sales proceeds, may be subject to withholding under chapter 3 or chapter 4 of the Code (sections 1441–1474). Under those rules, if a Form W-9 or other certification of non-foreign status has not been received, a withholding agent, transferee, or partnership (payor) generally applies presumption rules that may require the payor to withhold applicable tax from the recipient, owner, transferor, or partner (payee). See Pub. 515, Withholding of Tax on Nonresident Aliens and Foreign Entities.

The following persons must provide Form W-9 to the payor for purposes of establishing its non-foreign status.

• In the case of a disregarded entity with a U.S. owner, the U.S. owner of the disregarded entity and not the disregarded entity.

• In the case of a grantor trust with a U.S. grantor or other U.S. owner, generally, the U.S. grantor or other U.S. owner of the grantor trust and not the grantor trust.

• In the case of a U.S. trust (other than a grantor trust), the U.S. trust and not the beneficiaries of the trust.

See Pub. 515 for more information on providing a Form W-9 or a certification of non-foreign status to avoid withholding.

Foreign person. If you are a foreign person or the U.S. branch of a foreign bank that has elected to be treated as a U.S. person (under Regulations section 1.1441-1(b)(2)(iv) or other applicable section for chapter 3 or 4 purposes), do not use Form W-9. Instead, use the appropriate Form W-8 or Form 8233 (see Pub. 515). If you are a qualified foreign pension fund under Regulations section 1.897(l)-1(d), or a partnership that is wholly owned by qualified foreign pension funds, that is treated as a non-foreign person for purposes of section 1445 withholding, do not use Form W-9. Instead, use Form W-8EXP (or other certification of non-foreign status).

Nonresident alien who becomes a resident alien. Generally, only a nonresident alien individual may use the terms of a tax treaty to reduce or eliminate U.S. tax on certain types of income. However, most tax treaties contain a provision known as a saving clause. Exceptions specified in the saving clause may permit an exemption from tax to continue for certain types of income even after the payee has otherwise become a U.S. resident alien for tax purposes.

If you are a U.S. resident alien who is relying on an exception contained in the saving clause of a tax treaty to claim an exemption from U.S. tax on certain types of income, you must attach a statement to Form W-9 that specifies the following five items.

1. The treaty country. Generally, this must be the same treaty under which you claimed exemption from tax as a nonresident alien.

2. The treaty article addressing the income.

3. The article number (or location) in the tax treaty that contains the saving clause and its exceptions.

4. The type and amount of income that qualifies for the exemption from tax.

5. Sufficient facts to justify the exemption from tax under the terms of the treaty article.

Example. Article 20 of the U.S.-China income tax treaty allows an exemption from tax for scholarship income received by a Chinese student temporarily present in the United States. Under U.S. law, this student will become a resident alien for tax purposes if their stay in the United States exceeds 5 calendar years. However, paragraph 2 of the first Protocol to the U.S.-China treaty (dated April 30, 1984) allows the provisions of Article 20 to continue to apply even after the Chinese student becomes a resident alien of the United States. A Chinese student who qualifies for this exception (under paragraph 2 of the first Protocol) and is relying on this exception to claim an exemption from tax on their scholarship or fellowship income would attach to Form W-9 a statement that includes the information described above to support that exemption.

If you are a nonresident alien or a foreign entity, give the requester the appropriate completed Form W-8 or Form 8233.

Backup Withholding

What is backup withholding? Persons making certain payments to you must under certain conditions withhold and pay to the IRS 24% of such payments. This is called "backup withholding." Payments that may be subject to backup withholding include, but are not limited to, interest, tax-exempt interest, dividends, broker and barter exchange transactions, rents, royalties, nonemployee pay, payments made in settlement of payment card and third-party network transactions, and certain payments from fishing boat operators. Real estate transactions are not subject to backup withholding.

You will not be subject to backup withholding on payments you receive if you give the requester your correct TIN, make the proper certifications, and report all your taxable interest and dividends on your tax return.

Payments you receive will be subject to backup withholding if:

1. You do not furnish your TIN to the requester;

2. You do not certify your TIN when required (see the instructions for Part II for details);

3. The IRS tells the requester that you furnished an incorrect TIN;

4. The IRS tells you that you are subject to backup withholding because you did not report all your interest and dividends on your tax return (for reportable interest and dividends only); or

5. You do not certify to the requester that you are not subject to backup withholding, as described in item 4 under "*By signing the filled-out form*" above (for reportable interest and dividend accounts opened after 1983 only).

Certain payees and payments are exempt from backup withholding. See *Exempt payee code*, later, and the separate Instructions for the Requester of Form W-9 for more information.

See also *Establishing U.S. status for purposes of chapter 3 and chapter 4 withholding*, earlier.

What Is FATCA Reporting?

The Foreign Account Tax Compliance Act (FATCA) requires a participating foreign financial institution to report all U.S. account holders that are specified U.S. persons. Certain payees are exempt from FATCA reporting. See *Exemption from FATCA reporting code*, later, and the Instructions for the Requester of Form W-9 for more information.

Updating Your Information

You must provide updated information to any person to whom you claimed to be an exempt payee if you are no longer an exempt payee and anticipate receiving reportable payments in the future from this person. For example, you may need to provide updated information if you are a C corporation that elects to be an S corporation, or if you are no longer tax exempt. In addition, you must furnish a new Form W-9 if the name or TIN changes for the account, for example, if the grantor of a grantor trust dies.

Penalties

Failure to furnish TIN. If you fail to furnish your correct TIN to a requester, you are subject to a penalty of $50 for each such failure unless your failure is due to reasonable cause and not to willful neglect.

Civil penalty for false information with respect to withholding. If you make a false statement with no reasonable basis that results in no backup withholding, you are subject to a $500 penalty.

Criminal penalty for falsifying information. Willfully falsifying certifications or affirmations may subject you to criminal penalties including fines and/or imprisonment.

Misuse of TINs. If the requester discloses or uses TINs in violation of federal law, the requester may be subject to civil and criminal penalties.

Specific Instructions

Line 1

You must enter one of the following on this line; **do not** leave this line blank. The name should match the name on your tax return.

If this Form W-9 is for a joint account (other than an account maintained by a foreign financial institution (FFI)), list first, and then circle, the name of the person or entity whose number you entered in Part I of Form W-9. If you are providing Form W-9 to an FFI to document a joint account, each holder of the account that is a U.S. person must provide a Form W-9.

• **Individual.** Generally, enter the name shown on your tax return. If you have changed your last name without informing the Social Security Administration (SSA) of the name change, enter your first name, the last name as shown on your social security card, and your new last name.

Note for ITIN applicant: Enter your individual name as it was entered on your Form W-7 application, line 1a. This should also be the same as the name you entered on the Form 1040 you filed with your application.

• **Sole proprietor.** Enter your individual name as shown on your Form 1040 on line 1. Enter your business, trade, or "doing business as" (DBA) name on line 2.

• **Partnership, C corporation, S corporation, or LLC, other than a disregarded entity.** Enter the entity's name as shown on the entity's tax return on line 1 and any business, trade, or DBA name on line 2.

• **Other entities.** Enter your name as shown on required U.S. federal tax documents on line 1. This name should match the name shown on the charter or other legal document creating the entity. Enter any business, trade, or DBA name on line 2.

• **Disregarded entity.** In general, a business entity that has a single owner, including an LLC, and is not a corporation, is disregarded as an entity separate from its owner (a disregarded entity). See Regulations section 301.7701-2(c)(2). A disregarded entity should check the appropriate box for the tax classification of its owner. Enter the owner's name on line 1. The name of the owner entered on line 1 should never be a disregarded entity. The name on line 1 should be the name shown on the income tax return on which the income should be reported. For example, if a foreign LLC that is treated as a disregarded entity for U.S. federal tax purposes has a single owner that is a U.S. person, the U.S. owner's name is required to be provided on line 1. If the direct owner of the entity is also a disregarded entity, enter the first owner that is not disregarded for federal tax purposes. Enter the disregarded entity's name on line 2. If the owner of the disregarded entity is a foreign person, the owner must complete an appropriate Form W-8 instead of a Form W-9. This is the case even if the foreign person has a U.S. TIN.

Line 2

If you have a business name, trade name, DBA name, or disregarded entity name, enter it on line 2.

Line 3a

Check the appropriate box on line 3a for the U.S. federal tax classification of the person whose name is entered on line 1. Check only one box on line 3a.

IF the entity/individual on line 1 is a(n) . . .	THEN check the box for . . .
• Corporation	Corporation.
• Individual or • Sole proprietorship	Individual/sole proprietor.
• LLC classified as a partnership for U.S. federal tax purposes or • LLC that has filed Form 8832 or 2553 electing to be taxed as a corporation	Limited liability company and enter the appropriate tax classification: P = Partnership, C = C corporation, or S = S corporation.
• Partnership	Partnership.
• Trust/estate	Trust/estate.

Line 3b

Check this box if you are a partnership (including an LLC classified as a partnership for U.S. federal tax purposes), trust, or estate that has any foreign partners, owners, or beneficiaries, and you are providing this form to a partnership, trust, or estate, in which you have an ownership interest. You must check the box on line 3b if you receive a Form W-8 (or documentary evidence) from any partner, owner, or beneficiary establishing foreign status or if you receive a Form W-9 from any partner, owner, or beneficiary that has checked the box on line 3b.

Note: A partnership that provides a Form W-9 and checks box 3b may be required to complete Schedules K-2 and K-3 (Form 1065). For more information, see the Partnership Instructions for Schedules K-2 and K-3 (Form 1065).

If you are required to complete line 3b but fail to do so, you may not receive the information necessary to file a correct information return with the IRS or furnish a correct payee statement to your partners or beneficiaries. See, for example, sections 6698, 6722, and 6724 for penalties that may apply.

Line 4 Exemptions

If you are exempt from backup withholding and/or FATCA reporting, enter in the appropriate space on line 4 any code(s) that may apply to you.

Exempt payee code.

• Generally, individuals (including sole proprietors) are not exempt from backup withholding.

• Except as provided below, corporations are exempt from backup withholding for certain payments, including interest and dividends.

• Corporations are not exempt from backup withholding for payments made in settlement of payment card or third-party network transactions.

• Corporations are not exempt from backup withholding with respect to attorneys' fees or gross proceeds paid to attorneys, and corporations that provide medical or health care services are not exempt with respect to payments reportable on Form 1099-MISC.

The following codes identify payees that are exempt from backup withholding. Enter the appropriate code in the space on line 4.

1—An organization exempt from tax under section 501(a), any IRA, or a custodial account under section 403(b)(7) if the account satisfies the requirements of section 401(f)(2).

2—The United States or any of its agencies or instrumentalities.

3—A state, the District of Columbia, a U.S. commonwealth or territory, or any of their political subdivisions or instrumentalities.

4—A foreign government or any of its political subdivisions, agencies, or instrumentalities.

5—A corporation.

6—A dealer in securities or commodities required to register in the United States, the District of Columbia, or a U.S. commonwealth or territory.

7—A futures commission merchant registered with the Commodity Futures Trading Commission.

8—A real estate investment trust.

9—An entity registered at all times during the tax year under the Investment Company Act of 1940.

10—A common trust fund operated by a bank under section 584(a).

11—A financial institution as defined under section 581.

12—A middleman known in the investment community as a nominee or custodian.

13—A trust exempt from tax under section 664 or described in section 4947.

The following chart shows types of payments that may be exempt from backup withholding. The chart applies to the exempt payees listed above, 1 through 13.

IF the payment is for . . .	THEN the payment is exempt for . . .
• Interest and dividend payments	All exempt payees except for 7.
• Broker transactions	Exempt payees 1 through 4 and 6 through 11 and all C corporations. S corporations must not enter an exempt payee code because they are exempt only for sales of noncovered securities acquired prior to 2012.
• Barter exchange transactions and patronage dividends	Exempt payees 1 through 4.
• Payments over $600 required to be reported and direct sales over $5,000[1]	Generally, exempt payees 1 through 5.[2]
• Payments made in settlement of payment card or third-party network transactions	Exempt payees 1 through 4.

[1] See Form 1099-MISC, Miscellaneous Information, and its instructions.

[2] However, the following payments made to a corporation and reportable on Form 1099-MISC are not exempt from backup withholding: medical and health care payments, attorneys' fees, gross proceeds paid to an attorney reportable under section 6045(f), and payments for services paid by a federal executive agency.

Exemption from FATCA reporting code. The following codes identify payees that are exempt from reporting under FATCA. These codes apply to persons submitting this form for accounts maintained outside of the United States by certain foreign financial institutions. Therefore, if you are only submitting this form for an account you hold in the United States, you may leave this field blank. Consult with the person requesting this form if you are uncertain if the financial institution is subject to these requirements. A requester may indicate that a code is not required by providing you with a Form W-9 with "Not Applicable" (or any similar indication) entered on the line for a FATCA exemption code.

A—An organization exempt from tax under section 501(a) or any individual retirement plan as defined in section 7701(a)(37).

B—The United States or any of its agencies or instrumentalities.

C—A state, the District of Columbia, a U.S. commonwealth or territory, or any of their political subdivisions or instrumentalities.

D—A corporation the stock of which is regularly traded on one or more established securities markets, as described in Regulations section 1.1472-1(c)(1)(i).

E—A corporation that is a member of the same expanded affiliated group as a corporation described in Regulations section 1.1472-1(c)(1)(i).

F—A dealer in securities, commodities, or derivative financial instruments (including notional principal contracts, futures, forwards, and options) that is registered as such under the laws of the United States or any state.

G—A real estate investment trust.

H—A regulated investment company as defined in section 851 or an entity registered at all times during the tax year under the Investment Company Act of 1940.

I—A common trust fund as defined in section 584(a).

J—A bank as defined in section 581.

K—A broker.

L—A trust exempt from tax under section 664 or described in section 4947(a)(1).

M—A tax-exempt trust under a section 403(b) plan or section 457(g) plan.

Note: You may wish to consult with the financial institution requesting this form to determine whether the FATCA code and/or exempt payee code should be completed.

Line 5

Enter your address (number, street, and apartment or suite number). This is where the requester of this Form W-9 will mail your information returns. If this address differs from the one the requester already has on file, enter "NEW" at the top. If a new address is provided, there is still a chance the old address will be used until the payor changes your address in their records.

Line 6

Enter your city, state, and ZIP code.

Part I. Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. If you are a resident alien and you do not have, and are not eligible to get, an SSN, your TIN is your IRS ITIN. Enter it in the entry space for the Social security number. If you do not have an ITIN, see *How to get a TIN* below.

If you are a sole proprietor and you have an EIN, you may enter either your SSN or EIN.

If you are a single-member LLC that is disregarded as an entity separate from its owner, enter the owner's SSN (or EIN, if the owner has one). If the LLC is classified as a corporation or partnership, enter the entity's EIN.

Note: See *What Name and Number To Give the Requester*, later, for further clarification of name and TIN combinations.

How to get a TIN. If you do not have a TIN, apply for one immediately. To apply for an SSN, get Form SS-5, Application for a Social Security Card, from your local SSA office or get this form online at *www.SSA.gov*. You may also get this form by calling 800-772-1213. Use Form W-7, Application for IRS Individual Taxpayer Identification Number, to apply for an ITIN, or Form SS-4, Application for Employer Identification Number, to apply for an EIN. You can apply for an EIN online by accessing the IRS website at *www.irs.gov/EIN*. Go to *www.irs.gov/Forms* to view, download, or print Form W-7 and/or Form SS-4. Or, you can go to *www.irs.gov/OrderForms* to place an order and have Form W-7 and/or Form SS-4 mailed to you within 15 business days.

If you are asked to complete Form W-9 but do not have a TIN, apply for a TIN and enter "Applied For" in the space for the TIN, sign and date the form, and give it to the requester. For interest and dividend payments, and certain payments made with respect to readily tradable instruments, you will generally have 60 days to get a TIN and give it to the requester before you are subject to backup withholding on payments. The 60-day rule does not apply to other types of payments. You will be subject to backup withholding on all such payments until you provide your TIN to the requester.

Note: Entering "Applied For" means that you have already applied for a TIN or that you intend to apply for one soon. See also *Establishing U.S. status for purposes of chapter 3 and chapter 4 withholding*, earlier, for when you may instead be subject to withholding under chapter 3 or 4 of the Code.

Caution: A disregarded U.S. entity that has a foreign owner must use the appropriate Form W-8.

Part II. Certification

To establish to the withholding agent that you are a U.S. person, or resident alien, sign Form W-9. You may be requested to sign by the withholding agent even if item 1, 4, or 5 below indicates otherwise.

For a joint account, only the person whose TIN is shown in Part I should sign (when required). In the case of a disregarded entity, the person identified on line 1 must sign. Exempt payees, see *Exempt payee code*, earlier.

Signature requirements. Complete the certification as indicated in items 1 through 5 below.

1. Interest, dividend, and barter exchange accounts opened before 1984 and broker accounts considered active during 1983. You must give your correct TIN, but you do not have to sign the certification.

2. Interest, dividend, broker, and barter exchange accounts opened after 1983 and broker accounts considered inactive during 1983. You must sign the certification or backup withholding will apply. If you are subject to backup withholding and you are merely providing your correct TIN to the requester, you must cross out item 2 in the certification before signing the form.

3. Real estate transactions. You must sign the certification. You may cross out item 2 of the certification.

4. Other payments. You must give your correct TIN, but you do not have to sign the certification unless you have been notified that you have previously given an incorrect TIN. "Other payments" include payments made in the course of the requester's trade or business for rents, royalties, goods (other than bills for merchandise), medical and health care services (including payments to corporations), payments to a nonemployee for services, payments made in settlement of payment card and third-party network transactions, payments to certain fishing boat crew members and fishermen, and gross proceeds paid to attorneys (including payments to corporations).

5. Mortgage interest paid by you, acquisition or abandonment of secured property, cancellation of debt, qualified tuition program payments (under section 529), ABLE accounts (under section 529A), IRA, Coverdell ESA, Archer MSA or HSA contributions or distributions, and pension distributions. You must give your correct TIN, but you do not have to sign the certification.

What Name and Number To Give the Requester

For this type of account:	Give name and SSN of:
1. Individual	The individual
2. Two or more individuals (joint account) other than an account maintained by an FFI	The actual owner of the account or, if combined funds, the first individual on the account[1]
3. Two or more U.S. persons (joint account maintained by an FFI)	Each holder of the account
4. Custodial account of a minor (Uniform Gift to Minors Act)	The minor[2]
5. a. The usual revocable savings trust (grantor is also trustee)	The grantor-trustee[1]
b. So-called trust account that is not a legal or valid trust under state law	The actual owner[1]
6. Sole proprietorship or disregarded entity owned by an individual	The owner[3]
7. Grantor trust filing under Optional Filing Method 1 (see Regulations section 1.671-4(b)(2)(i)(A))**	The grantor*
8. Disregarded entity not owned by an individual	The owner
9. A valid trust, estate, or pension trust	Legal entity[4]
10. Corporation or LLC electing corporate status on Form 8832 or Form 2553	The corporation
11. Association, club, religious, charitable, educational, or other tax-exempt organization	The organization
12. Partnership or multi-member LLC	The partnership
13. A broker or registered nominee	The broker or nominee
14. Account with the Department of Agriculture in the name of a public entity (such as a state or local government, school district, or prison) that receives agricultural program payments	The public entity
15. Grantor trust filing Form 1041 or under the Optional Filing Method 2, requiring Form 1099 (see Regulations section 1.671-4(b)(2)(i)(B))**	The trust

[1] List first and circle the name of the person whose number you furnish. If only one person on a joint account has an SSN, that person's number must be furnished.

[2] Circle the minor's name and furnish the minor's SSN.

[3] You must show your individual name on line 1, and enter your business or DBA name, if any, on line 2. You may use either your SSN or EIN (if you have one), but the IRS encourages you to use your SSN.

[4] List first and circle the name of the trust, estate, or pension trust. (Do not furnish the TIN of the personal representative or trustee unless the legal entity itself is not designated in the account title.)

* **Note:** The grantor must also provide a Form W-9 to the trustee of the trust.

** For more information on optional filing methods for grantor trusts, see the Instructions for Form 1041.

Note: If no name is circled when more than one name is listed, the number will be considered to be that of the first name listed.

Secure Your Tax Records From Identity Theft

Identity theft occurs when someone uses your personal information, such as your name, SSN, or other identifying information, without your permission to commit fraud or other crimes. An identity thief may use your SSN to get a job or may file a tax return using your SSN to receive a refund.

To reduce your risk:

- Protect your SSN,
- Ensure your employer is protecting your SSN, and
- Be careful when choosing a tax return preparer.

If your tax records are affected by identity theft and you receive a notice from the IRS, respond right away to the name and phone number printed on the IRS notice or letter.

If your tax records are not currently affected by identity theft but you think you are at risk due to a lost or stolen purse or wallet, questionable credit card activity, or a questionable credit report, contact the IRS Identity Theft Hotline at 800-908-4490 or submit Form 14039.

For more information, see Pub. 5027, Identity Theft Information for Taxpayers.

Victims of identity theft who are experiencing economic harm or a systemic problem, or are seeking help in resolving tax problems that have not been resolved through normal channels, may be eligible for Taxpayer Advocate Service (TAS) assistance. You can reach TAS by calling the TAS toll-free case intake line at 877-777-4778 or TTY/TDD 800-829-4059.

Protect yourself from suspicious emails or phishing schemes. Phishing is the creation and use of email and websites designed to mimic legitimate business emails and websites. The most common act is sending an email to a user falsely claiming to be an established legitimate enterprise in an attempt to scam the user into surrendering private information that will be used for identity theft.

The IRS does not initiate contacts with taxpayers via emails. Also, the IRS does not request personal detailed information through email or ask taxpayers for the PIN numbers, passwords, or similar secret access information for their credit card, bank, or other financial accounts.

If you receive an unsolicited email claiming to be from the IRS, forward this message to *phishing@irs.gov*. You may also report misuse of the IRS name, logo, or other IRS property to the Treasury Inspector General for Tax Administration (TIGTA) at 800-366-4484. You can forward suspicious emails to the Federal Trade Commission at *spam@uce.gov* or report them at *www.ftc.gov/complaint*. You can contact the FTC at *www.ftc.gov/idtheft* or 877-IDTHEFT (877-438-4338). If you have been the victim of identity theft, see *www.IdentityTheft.gov* and Pub. 5027.

Go to *www.irs.gov/IdentityTheft* to learn more about identity theft and how to reduce your risk.

Privacy Act Notice

Section 6109 of the Internal Revenue Code requires you to provide your correct TIN to persons (including federal agencies) who are required to file information returns with the IRS to report interest, dividends, or certain other income paid to you; mortgage interest you paid; the acquisition or abandonment of secured property; the cancellation of debt; or contributions you made to an IRA, Archer MSA, or HSA. The person collecting this form uses the information on the form to file information returns with the IRS, reporting the above information. Routine uses of this information include giving it to the Department of Justice for civil and criminal litigation and to cities, states, the District of Columbia, and U.S. commonwealths and territories for use in administering their laws. The information may also be disclosed to other countries under a treaty, to federal and state agencies to enforce civil and criminal laws, or to federal law enforcement and intelligence agencies to combat terrorism. You must provide your TIN whether or not you are required to file a tax return. Under section 3406, payors must generally withhold a percentage of taxable interest, dividends, and certain other payments to a payee who does not give a TIN to the payor. Certain penalties may also apply for providing false or fraudulent information.

CONFLICT OF INTEREST QUESTIONNAIRE

For vendor doing business with local governmental entity

SAMPLE

FORM CIQ

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. *See* Section 176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.

OFFICE USE ONLY

Date Received

1 **Name of vendor who has a business relationship with local governmental entity.**

Company/Independent Contractor's Name

2 ☐ **Check this box if you are filing an update to a previously filed questionnaire.** (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

3 **Name of local government officer about whom the information is being disclosed.**

Enter "N/A" if there is no employment of business relationship

Name of Officer

4 **Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.**

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

☐ Yes ☐ No **At least one box must be checked**

B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?

☐ Yes ☐ No **At least one box must be checked**

5 **Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.**

If a relationship exists, please describe it here

6 ☐ Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7

Signature

Signature of vendor doing business with the governmental entity

Date

Date

CONFLICT OF INTEREST QUESTIONNAIRE
For vendor doing business with local governmental entity

A complete copy of Chapter 176 of the Local Government Code may be found at http://www.statutes.legis.state.tx.us/Docs/LG/htm/LG.176.htm. For easy reference, below are some of the sections cited on this form.

Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on:

(A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity;

(B) a transaction conducted at a price and subject to terms available to the public; or

(C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency.

Local Government Code § 176.003(a)(2)(A) and (B):

(a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if:

***

(2) the vendor:

(A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds $2,500 during the 12-month period preceding the date that the officer becomes aware that

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor;

(B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than $100 in the 12-month period preceding the date the officer becomes aware that:

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor.

Local Government Code § 176.006(a) and (a-1)

(a) A vendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and:

(1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A);

(2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or

(3) has a family relationship with a local government officer of that local governmental entity.

(a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of:

(1) the date that the vendor:

(A) begins discussions or negotiations to enter into a contract with the local governmental entity; or

(B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or

(2) the date the vendor becomes aware:

(A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a);

(B) that the vendor has given one or more gifts described by Subsection (a); or

(C) of a family relationship with a local government officer.

CONFLICT OF INTEREST QUESTIONNAIRE

For vendor doing business with local governmental entity

FORM CIQ

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. *See* Section 176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.

OFFICE USE ONLY

Date Received

1 **Name of vendor who has a business relationship with local governmental entity.**

2 ☐ **Check this box if you are filing an update to a previously filed questionnaire.** (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

3 **Name of local government officer about whom the information is being disclosed.**

_____

Name of Officer

4 **Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.**

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

☐ Yes ☐ No

B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?

☐ Yes ☐ No

5 **Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.**

6 ☐ Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7

_____ _____

Signature of vendor doing business with the governmental entity Date

CERTIFICATE OF INTERESTED PARTIES FORM 1295

Certificate of Interested Parties (Form 1295) – Must be filled out electronically with the Texas Ethics Commission's online filing application, printed out, signed, and submitted to GPISD with the proposal.

GPISD is required to comply with House Bill 1295, which amended the Texas Government Code by adding Section 2252.908, Disclosure of Interested Parties. Section 2252.908 prohibits GPISD from entering into a contract resulting from this solicitation with a business entity unless the business entity submits a Disclosure of Interested Parties (Form 1295) to GPISD at the time business entity submits the signed contract. Effective January 1, 2018, the Form 1295 requirement does not apply to: (1) a contract with a publicly traded business entity or wholly owned subsidiary of the same; (2) an electric utility; or (3) a gas utility. The Texas Ethics Commission has adopted rules requiring the business entity to file Form 1295 electronically with the Texas Ethics Commission. The following definitions apply:

"Business Entity" means an entity recognized by law through which business is conducted, including a sole proprietorship, partnership, or corporation. TEX. GOV'T CODE § 2252.908(1).

"Interested Party" means a person who has a controlling interest in a business entity with whom GPISD contracts or who actively participates in facilitating the contract or negotiating the terms of the contract, including a broker, intermediary, adviser, or attorney for the business entity. TEX. GOV'T CODE § 2252.908(3).

"Controlling interest" means an Districtship interest or participating interest in a business entity by virtue of units, percentage, shares, stock, or otherwise that exceeds 10 percent; membership on the board of directors or other governing body of a business entity of which the board or other governing body is composed of not more than 10 members; or service as an officer of a business entity that has four or fewer officers, or service as one of the four officers most highly compensated by a business entity that has more than four officers. *Subsection (c) does not apply to an officer of a publicly held business entity or its wholly owned subsidiaries.* TEX. ETHICS COMM. RULE 46.3(c).

"Intermediary" means a person who actively participates in the facilitation of the contract or negotiating the contract, including a broker, adviser, attorney, or representative of or agent for the business entity who receives compensation from the business entity for the person's participation; communicates directly with the governmental entity or state agency on behalf of the business entity regarding the contract; and is not an employee of the business entity. TEX. ETHICS COMM. RULE 46.3(e).

As a "business entity," unless an exception applies, Vendors must:

1. Complete Form 1295 electronically with the Texas Ethics Commission using the online filing application, which can be found at **https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm**
    a. All Vendors must complete Form 1295, even if no interested parties exist, unless Vendor is a publicly traded business entity or wholly owned subsidiary of the same, an electric utility or a gas utility.
    b. In Section 2, insert "Galena Park Independent School District"
    c. In Section 3, insert the GPISD RFP/RFQ # for this proposal
2. Print a copy of the completed form (make sure that it has a computer-generated certification number in the "Office Use Only" box);
3. Have an authorized agent of the business entity sign the form; and
4. Submit the completed, signed Form 1295 by attaching the form to your proposal.

GPISD must notify the Texas Ethics Commission of the receipt of the filed Form 1295 no later than the 30th day after receipt by GPISD. After GPISD acknowledges the Form 1295, the Texas Ethics Commission is required to post the completed Form 1295 to its website within seven business days after receiving notice from GPISD.

CERTIFICATE OF INTERESTED PARTIES

FORM 1295

Complete Nos. 1 - 4 and 6 if there are interested parties.
Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.

OFFICE USE ONLY

1 Name of business entity filing form, and the city, state and country of the business entity's place of business.

Business Company Name

2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.

Galena Park ISD

3 Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the services, goods, or other property to be provided under the contract.

Bid RFP # and Name of RFP (Co-op Contract optional)

4

Name of Interested Party	City, State, Country (place of business)	Nature of Interest (check applicable)	
		Controlling	Intermediary
Business Company Owners			

5 Check only if there is NO Interested Party. ☐

6 UNSWORN DECLARATION

My name is _____, and my date of birth is _____.

My address is _____, _____, _____, _____, _____.
(street) (city) (state) (zip code) (country)

I declare under penalty of perjury that the foregoing is true and correct.

Executed in _____ County, State of _____ , on the _____ day of _____, 20_____.
(month) (year)

_____
Signature of authorized agent of contracting business entity
(Declarant)

ADD ADDITIONAL PAGES AS NECESSARY

Must file online at www.ethics.state.tx.us/File

STATE AND FEDERAL CERTIFICATION FORM

Accordingly, the parties agree that the following terms and conditions apply to the Contract between the District and vendor ("Vendor") to the extent applicable to the contract type or dollar amount:

CERTIFICATION REGARDING TERRORIST ORGANIZATIONS & BOYCOTTING OF ISRAEL

Vendor hereby certifies that it is not a company identified on the Texas Comptroller's list of companies known to have contracts with, or provide supplies or services to, a foreign organization designated as a Foreign Terrorist Organization by the U.S. Secretary of State. Vendor further certifies and verifies that neither Vendor, nor any affiliate, subsidiary, or parent company of Vendor, if any (the "Vendor Companies"), boycotts Israel, and Vendor agrees that Vendor and Vendor Companies will not boycott Israel during the term of this Agreement. For purposes of this Agreement, the term "boycott" shall mean and include terminating business activities or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory.

VERIFICATION REGARDING CONTRACTS WITH COMPANIES THAT BOYCOTT ENERGY COMPANIES

If Vendor is required to make a verification pursuant to Section 2274.002 of the Texas Government Code, Vendor hereby verifies that it does not, and will not for the duration of the contract, boycott energy companies. "Boycott energy company" means, without an ordinary business purpose, refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations with a company because the company: (A) engages in the exploration, production, utilization, transportation, sale, or manufacturing of fossil fuel-based energy and does not commit or pledge to meet environmental standards beyond applicable federal and state law; or (B) does business with a company described by Paragraph (A). *[Verification does not apply to a vendor that employs less than 10 full-time employees; **AND** the value of the contract is less than $100,000 – Note that the term "company" does not include a sole proprietorship.]*

VERIFICATION REGARDING CONTRACTS WITH COMPANIES THAT DISCRIMINATE AGAINST FIREARMS ENTITY OR TRADE ASSOCIATION

If Vendor is required to make a verification pursuant to Section 2274.002 of the Texas Government Code, Vendor hereby verifies that it (1) does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association and (2) will not discriminate during the term of the contract against a firearm entity or firearm trade association. *[Verification does not apply to a vendor that employs less than 10 full-time employees; **AND** the value of the contract is less than $100,000 – Note that the term "company" does not include a sole proprietorship.]*

REQUIRED CONTRACT PROVISIONS FOR NON-FEDERAL ENTITY CONTRACTS UNDER FEDERAL AWARDS APPENDIX II TO 2 CFR PART 200

(A) [*Applicable ONLY to contracts in excess of $250,000.*] **Contracts for more than the simplified acquisition threshold currently set at $250,000, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate.**

Pursuant to Federal Rule (A) above, when the District expends federal funds, the District reserves all rights and privileges under the applicable laws and regulations with respect to this procurement in the event of breach of contract by either party.

(B) [*Applicable ONLY to contracts in excess of $10,000.*] **Termination for cause and for convenience by the grantee or subgrantee including the manner by which it will be affected and the basis for settlement.**

Pursuant to Federal Rule (B) above, when the District expends federal funds, the District reserves the right to immediately terminate any agreement in excess of $10,000 resulting from this procurement process in the event of a breach or default of the agreement by Vendor in the event Vendor fails to: (1) meet schedules, deadlines, and/or delivery dates within the time specified in the procurement solicitation, contract, and/or a purchase order; (2) make any payments owed; or (3) otherwise perform in accordance with the contract and/or the procurement solicitation. The District also reserves the right to terminate the contract immediately, with written notice to vendor, for convenience, if the District believes, in its sole discretion that it is in the best interest of the District to do so. Vendor will be compensated for work performed and accepted and goods accepted by the District as of the termination date if the contract is terminated for convenience of the District. Any award under this procurement process is not exclusive and the District reserves the right to purchase goods and services from other vendors when it is in the District's best interest.

(**C)** [*Applicable ONLY to federally assisted construction contracts.*] **Equal Employment Opportunity. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity" (30 FR 12319, 12935, 3 CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor."**

Pursuant to Federal Rule (C) above, when the District expends federal funds on any federally assisted construction contract, the equal opportunity clause is incorporated by reference herein.

(D) [*Applicable ONLY to prime construction contracts in excess of $2,000 where federal funds are being used for the project*] **Davis-Bacon Act, as amended (40 U.S.C. 3141-3148). When required by Federal program legislation, all prime construction contracts in excess of $2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146-3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.**

(E) [*Applicable ONLY to contracts in excess of $100,000 involving mechanics or laborers.*] **Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708). Where applicable, all contracts awarded by the non-Federal entity in excess of $100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.**

Pursuant to Federal Rule (E) above, when the District expends federal funds, Vendor certifies that Vendor will be in compliance with all applicable provisions of the Contract Work Hours and Safety Standards Act during the term of an award for all contracts by the District resulting from this procurement process.

(F) Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of "funding agreement" under 37 CFR §401.2 (a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that "funding agreement," the recipient or subrecipient must comply with the requirements of 37 CFR Part 401, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency.

Pursuant to Federal Rule (F) above, when federal funds are expended by the District, Vendor certifies that during the term of an award for all contracts by the District resulting from this procurement process, Vendor agrees to comply with all applicable requirements as referenced in Federal Rule (F) above.

(G) [*Applicable ONLY to contracts in excess of $250,000.*] **Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended—Contracts and subgrants of amounts in excess of $250,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251- 1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).**

Pursuant to Federal Rule (G) above, when federal funds are expended by the District, Vendor certifies that during the term of an award for all contracts by the District resulting from this procurement process, Vendor agrees to comply with all applicable requirements as referenced in Federal Rule (G) above.

(H) Debarment and Suspension (Executive Orders 12549 and 12689)—A contract award (see 2 CFR 180.220) must not be made to parties listed on the government wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

Pursuant to Federal Rule (H) above, when federal funds are expended by the District, Vendor certifies that during the term of an award for all contracts by the District resulting from this procurement process, Vendor certifies that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation by any federal department or agency.

(I) [*Applicable ONLY to contracts in excess of $100,000*] **Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)—Contractors that apply or bid for an award exceeding $100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.**

Pursuant to Federal Rule (I) above, when federal funds are expended by the District, Vendor certifies that during the term and after the awarded term of an award for all contracts by the District resulting from this procurement process, the vendor certifies that it is in compliance with all applicable provisions of the Byrd Anti-Lobbying Amendment (31 U.S.C. 1352). The undersigned further certifies that:

(1) No Federal appropriated funds have been paid or will be paid for on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of congress, or an employee of a Member of Congress in connection with the awarding of

a Federal contract, the making of a Federal grant, the making of a Federal loan, the entering into a cooperative agreement, and the extension, continuation, renewal, amendment, or modification of a Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of congress, or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying", in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all covered sub-awards exceeding $100,000 in Federal funds at all appropriate tiers and that all subrecipients shall certify and disclose accordingly.

(J) Procurement of Recovered Materials – When federal funds are expended, the District and its contractors must comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include: (1) procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds $10,000 or the value of the quantity acquired during the preceding fiscal year exceeded $10,000; (2) procuring solid waste management services in a manner that maximizes energy and resource recovery; and (3) establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.

Pursuant to Federal Rule (J) above, when federal funds are expended by the District, as required by the Resource Conservation and Recovery Act of 1976 (42 U.S.C. § 6962(c)(3)(A)(i)), the vendor certifies, by signing this document, that the percentage of recovered materials content for EPA-designated items to be delivered or used in the performance of the contract will be at least the amount required by the applicable contract specifications or other contractual requirements.

(K) Domestic Preferences for Procurements – As appropriate and to the extent consistent with law, the non-Federal entity should, to the greatest extent practicable under a Federal award, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products). The requirements of this section must be included in all subawards including all contracts and purchase orders for work or products under this award. For purposes of 2 CFR Part 200.322, "Produced in the United States" means, for iron and steel products, that all manufacturing processes, from the initial melting stag through the application of coatings, occurred in the United States. Moreover, for purposes of 2 CFR Part 200.322, "Manufactured products" means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum, plastics and polymer-based products such as polyvinyl chloride pipe, aggregates such as concrete, class, including optical fiber, and lumber.

Pursuant to Federal Rule (K) above, when federal funds are expended by the District, vendor certifies, by signing this document, that to the greatest extent practicable vendor will provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products).

(L) Ban on Foreign Telecommunications – Federal grant funds may not be used to purchase equipment, services, or systems that use "covered telecommunications" equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. "Covered telecommunications" means purchases from Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities), and video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).

Pursuant to Federal Rule (L) above, when federal funds are expended by the District, vendor certifies, by signing this document, vendor will not purchase equipment, services, or systems that use "covered telecommunications", as defined by 2 CFR §200.216, equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.

RECORD RETENTION REQUIREMENTS FOR CONTRACTS INVOLVING FEDERAL FUNDS

When federal funds are expended by the District for any contract resulting from this procurement process, Vendor certifies that it will comply with the record retention requirements detailed in 2 CFR § 200.334. Vendor further certifies that it will retain all records as required by 2 CFR § 200.334 for a period of three years after grantees or subgrantees submit final expenditure reports or quarterly or annual financial reports, as applicable, and all other pending matters are closed.

CERTIFICATION OF COMPLIANCE WITH THE ENERGY POLICY AND CONSERVATION ACT

When the District expends federal funds for any contract resulting from this procurement process, Vendor certifies that it will comply with the mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 U.S.C. 6321 et seq.; 49 C.F.R. Part 18).

CERTIFICATION OF EQUAL EMPLOYMENT STATEMENT

It is the policy of the District not to discriminate on the basis of race, color, national origin, gender, limited English proficiency or handicapping conditions in its programs. Vendor agrees not to discriminate against any employee or applicant for employment to be employed in the performance of this Contract, with respect to hire, tenure, terms, conditions and privileges of employment, or a matter directly or indirectly related to employment, because of age (except where based on a bona fide occupational qualification), sex (except where based on a bona fide occupational qualification) or race, color, religion, national origin, or ancestry. Vendor further agrees that every subcontract entered into for the performance of this Contract shall contain a provision requiring non-discrimination in employment herein specified, binding upon each subcontractor. Breach of this covenant may be regarded as a material breach of the Contract.

CERTIFICATION OF COMPLIANCE WITH BUY AMERICA PROVISIONS

[*Only Applicable to Contracts funded under the National School Lunch Program*] The Buy American regulations promulgated by USDA and TDA require public school districts to purchase domestically grown and processed food to the maximum extent practicable. The food product must consist of agricultural commodities that were grown domestically, unless an authorized exception exists and has been approved by the District.

CERTIFICATION OF ACCESS TO RECORDS – 2 C.F.R. § 200.336

Vendor agrees that the District's Inspector General or any of their duly authorized representatives shall have access to any books, documents, papers and records of Vendor that are directly pertinent to Vendor's discharge of its obligations under the Contract for the purpose of making audits, examinations, excerpts, and transcriptions. The right also includes timely and reasonable access to Vendor's personnel for the purpose of interview and discussion relating to such documents.

CERTIFICATION OF APPLICABILITY TO SUBCONTRACTRS

Vendor agrees that all contracts it awards pursuant to the Contract shall be bound by the foregoing terms and conditions.

VENDOR AGREES TO COMPLY WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL LAWS, RULES, REGULATIONS, AND ORDINANCES. IT IS FURTHER ACKNOWLEDGED THAT VENDOR CERTIFIES COMPLIANCE WITH ALL PROVISIONS, LAWS, ACTS, REGULATIONS, ETC. AS SPECIFICALLY NOTED ABOVE.

Vendor's Name: _____

Address, City, State, and Zip Code: _____

Phone Number: _____ Fax Number: _____

Printed Name and Title of Authorized Representative: _____

Email Address: _____

Signature of Authorized Representative: _____

Date: _____

GALENA PARK INDEPENDENT SCHOOL DISTRICT
CERTIFICATION OF CRIMINAL HISTORY RECORD INFORMATION

THIS FORM MUST BE COMPLETED BY ALL SERVICE PROVIDERS

Section 1

Vendor (Name): _____

Contract Dates: _____ Drivers License Number: _____ Date of Birth: _____

Yes Will employees, including you have continuing duties related to the proposal or contract named above or any other services performed at GPISD?

Until further guidance is received, GPISD considers "continuing duties" to mean repetitive work duties rather than a onetime appearance or engagement.

Yes Will those employees, including yourself, have direct contact with students?

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. Examples include unsupervised coaching, tutoring, or other services to students. 19 Tex. Admin. Code § 153.1101(7).

If either question is answered "no" vendor should complete section 2 of this form.

If answer to both questions is "yes" vendor should complete section 3 of this form.

Section 2

I agree and understand employees of the company or individuals, including myself, who have not received the required criminal background check because the above description does not apply to them/myself will be considered visitors when on school campuses and must follow school district and campus policies related to visitors on school campuses.

_____ _____ _____

Signature of Vendor Print Name Date

Section 3

As a result of revised DPS procedures related to access to national criminal history record information, only NCPA qualified school district contractors have access to national criminal history record information. Accordingly, non-NCPA qualified contractors must cooperate with the school district in facilitating criminal history reviews when the school performs the DPS FACT Clearinghouse review of criminal history record information in place of the school contractor. Accordingly, contractors must certify one of the following, depending on whether contractor is NCPA-qualified.

☐ **NCPA Qualified**: The undersigned certifies that all employees, including myself, of the company that I own, operate, or manage, or myself as an independent contractor who have continuing duties related to the service to be performed on a GPISD campus and who also have direct contact with students have undergone the required criminal history background check or national criminal history record information review which may include fingerprints and photographs and that no prohibited contact as described herein was revealed.

OR

☐ **Non-NCPA Qualified**: The undersigned certifies that I have ensured that all employees, including myself, of the company that I own, operate, or manage, or myself as an independent contractor who have continuing duties related to the service to be performed on a GPISD campus and who also have direct contact with students have cooperated with GPISD in submitting all information necessary for GPISD to utilize its LEE Fast Pass procedure to perform the required criminal history background check or national criminal history record information review which may include fingerprints and photographs.

_____ _____ _____

Signature of Vendor Print Name Date

GALENA PARK INDEPENDENT SCHOOL DISTRICT

STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR BUILDING CONSTRUCTION CONTRACTS

Galena Park High School Phase 3A - New Fieldhouse

B104 002.3-2025

CSP # 25-500

[Contractor Name]
[Contractor Address]

STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR BUILDING CONSTRUCTION CONTRACTS

Agreement made as of August 11, 2025, between the Board of Trustees of the Galena Park Independent School District, hereinafter called the Owner,

and the Contractor:	**[Contractor Name]** **[Contractor Address]**
Project:	**Galena Park High School Phase 3A - New Fieldhouse**
Address:	**1000 Keene St. Galena Park, TX 77547**
Project #:	**B104 002.3-2025**
The Architect/Engineer is:	**PBK Architects, Inc.** **11 Greenway Plaza 22nd Floor, Houston, TX 77046**

The Contractor and the Owner for the consideration hereinafter named agree as follows:

ARTICLE 1. SCOPE OF WORK: The Contractor shall execute the entire Work described in the Contract Documents, except to the extent specifically indicated in the Contract Documents to be the responsibility of others. The Contract Documents are listed below; 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. The Contract Documents, in order of priority, are:

This Agreement (Standard Form of Agreement Between Owner and Contractor, as may be amended by duly executed and authorized Change Orders)
Uniform General Conditions of the Contract for Construction – Consisting of 26 Pages, as modified by the:
Supplementary Conditions of the Contract for Construction – Consisting of 3 Page(s)
Special Conditions of the Contract for Construction – Consisting of 2 Page(s)
Project Manual per Attachment "A" – Consisting of _xx_ Page(s)
Drawing List per Attachment "B" – Consisting of _xx_ Page(s)
Addendum #1 – Dated _____ – Consisting of ____ Page(s)

Alternates: The following Alternates, fully described in the Contract Documents, are included as a part of this Contract:

(ACCEPTED ALTERNATES WILL BE LISTED HERE)

Unit Prices: The following Unit Prices, fully described in the Contract Documents, are included as a part of this Contract:

(UNIT PRICES WILL BE LISTED HERE)

ARTICLE 2. TIME OF COMPLETION: The Work to be performed under this Contract shall be commenced within ten (10) days from the date of the Notice to Proceed issued by the Owner; and the Contractor shall achieve Substantial Completion within the time stipulated in the Supplementary Conditions of the Contract, subject to adjustments of this Contract Time as provided elsewhere in the Contract Documents. The time set forth for completion of the Work is an essential element of the Contract.

ARTICLE 3. THE CONTRACT SUM: The Owner shall pay the Contractor for performance of the Contract, subject to additions and deductions provided therein, the sum of

Base Bid	**$**	
Interior Printed and Custom Painted Graphics Allowance (lump sum)		**75,000.00**
Owner's Contingency Allowance		**900,000.00**
Written out [Dollars]	**$**	

and make payments on account as provided elsewhere in the Contract Documents.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement as of the day and year first written above.

ATTEST: (Notary Seal)

By:

_____
(notary signature)

_____
(notary name printed) (notary expiration date)

CONTRACTOR
[Contractor Name]

By: _____
(original signature)

_____
(name and title printed)

BOARD OF TRUSTEES GALENA PARK INDEPENDENT SCHOOL DISTRICT

By:

_____
Signature

_____
Print Name

_____
Title

CERTIFICATE OF APPROVAL

I hereby certify that pursuant to procedures authorized by the Board of Trustees of the Galena Park Independent School District, the foregoing Agreement was approved the 11 day of August in the year 2025, and that the person whose signature appears above is authorized to execute such Agreement on behalf of the Board.

INSTRUCTIONS FOR PERFORMANCE AND PAYMENT BONDS

1. The name, including full legal name, and business or residence address of each individual party to the bond shall be inserted in the space provided therefore, and each such party shall sign the bond with his/her usual signature on the line opposite his/her seal.

2. If the Principals are partners, their individual names shall appear in the space provided therefore, with the recital that they are partners composing a firm, naming it, and all the members of the firm shall execute the bond as individuals and as co-partners.

3. If the Principal or Surety is a corporation, the name of the state in which incorporated shall be inserted in the space provided therefore, and said instrument shall be executed and attested under the corporate seal as indicated in the form. If the Corporation has no corporate seal, the fact shall be stated, in which case a scroll of adhesive seal shall appear following the corporate name.

4. The official character and authority of the person or persons executing the bond of the Principal, if a corporation, shall be certified by the Secretary or Assistant Secretary, according to the form herein provided. In lieu of such certificate there may be attached to the bond copies of so much of the records of the corporation as will show the official character and authority of the officer signing, duly certified by the Secretary or Assistant Secretary, under the corporate seal, to be true copies.

THE DATE OF THE BOND MUST NOT BE PRIOR TO THE DATE OF THE STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR.

PERFORMANCE BOND FOR BUILDING CONSTRUCTION CONTRACTS

SURETY BOND NO. _____

STATE OF TEXAS _____

COUNTY OF _____

KNOW ALL PERSONS BY THESE PRESENTS: That we,

[Contractor Name]
[Contractor Address]

as Principal, hereinafter called Contractor, and
(Here insert full name and address or legal title of Surety)

as Surety, hereinafter called Surety, are held and firmly bound unto the Galena Park Independent School District as Obligee, hereinafter called the Owner, in the amount of

_____ Dollars

($ _____),
for payment whereof, the said Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

The conditions of this obligation are such that whereas the principal has by written agreement dated the 12 day of May in the year 2025, entered into a contract with the Owner for

Project:	**Galena Park High School Phase 3A - New Fieldhouse**
Address:	**1000 Keene St.Galena Park, TX 77547**
Project #:	**B104 002.3-2025**

in accordance with the Contract Documents prepared by

The Architect/Engineer is:	**PBK Architects, Inc.** **11 Greenway Plaza 22nd Floor, Houston, TX 77046**

which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW THEREFORE, the condition of this obligation is such that, if the Contractor shall faithfully perform the Contract in accordance with the Contract Documents, and shall fully indemnify and save harmless the Owner from all cost and damage which the Owner may suffer by reason of the Contractor's default or failure so to do and shall fully reimburse and repay the Owner all outlay and expense which the Owner may incur in making good any default, then this obligation shall be null and void, otherwise it shall remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253 of the Texas Government code as amended 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 the event the Contractor is declared in default under the Contract, Surety will within Fifteen (15) days of the Owner's declaration of such default take over and assume completion of said Contract and become entitled to the payment of the balance of the Contract Sum. Conditioned upon the Surety's faithful performance of its obligations, the liability of the Surety for the Contractor's default shall not exceed the penalty of this bond.

The Surety agrees to pay to the Owner upon demand all loss and expense, including attorney's fee, incurred by the Owner by reason of or on account of any breech of this agreement by Surety.

Provided further, that if any legal action be filed upon this bond, venue shall lie in Harris County, State of Texas.

IN WITNESS WHEREOF, the above bonded parties have executed this instrument under their several seals this

_____ day of _____in the year 20 _____, the name and corporate seals of each corporate party being hereto affixed, and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

ATTEST: (Notary Seal)

By: _____
(notary signature)

_____
(notary name printed) (notary expiration date)

PRINCIPAL

By: _____
(original signature)

_____
(name and title printed)

SURETY'S

By: _____
(original signature)

_____
(name and title printed)

SURETY HOME OFFICE SERVICING AGENT

_____
(name)

_____
(title)

_____
(address)

_____

_____
(Telephone)

CERTIFICATION AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the _____ secretary of the Corporation named as Principal in the within bond; that _____, who signed the said bond on behalf of the Principal, was then _____ of said corporation; that I know that person's signature thereon to be genuine; and that said bond was duly signed, sealed and attested for and in behalf of said Corporation by authority of its governing body.

(CORPORATE SEAL)

PAYMENT BOND FOR BUILDING CONSTRUCTION CONTRACTS

SURETY BOND NO. _____

STATE OF TEXAS _____

COUNTY OF _____

KNOW ALL PERSONS BY THESE PRESENTS: That we

[Contractor Name]
[Contractor Address]

as Principal, hereinafter called Contractor, and(Here insert full name and address or legal title of Surety)

as Surety, hereinafter called Surety, are held and firmly bound unto the Galena Park Independent School District as Obligee, hereinafter called the Owner, in the amount of

_____ Dollars

($ _____),
for payment whereof, the said Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

The conditions of this obligation are such that whereas the principal has by written agreement dated the 13 day of May in the year 2024, entered into a contract with the Owner for

Project:	**Galena Park High School Phase 3A - New Fieldhouse**
Address:	**1000 Keene St.Galena Park, TX 77547**
Project #:	**B104 002.3-2025**

in accordance with the Contract Documents prepared by

The Architect/Engineer is:	**PBK Architects, Inc.** **11 Greenway Plaza 22nd Floor, Houston, TX 77046**

which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.
NOW THEREFORE, the condition of this obligation is such that, if the Contractor shall promptly make payments to all claimants as defined in Chapter 2253 of the Texas Government Code as amended, of all persons supplying labor and materials in the prosecution of the work provided for in said Contract, then this obligation shall be null and void, but otherwise it shall remain in full force and effect. In the event Contractor fails to promptly pay when due persons who have supplied labor, materials, or supplies used in the performance of the said Contract, Surety will, upon receipt of notice from the Owner or a claim in the form required by law, satisfy all undisputed balances due, and make arrangements satisfactory to the interested parties to resolve all amounts disputed in good faith, but

in no event shall the liability of the Surety for the Contractor's failure to promptly pay for labor, materials, or supplies exceed the penalty of this bond.

The Surety agrees to pay to the Owner upon demand all loss and expense, including attorney's fee, incurred by the Owner by reason of or on account of any breech of this agreement by Surety.

Provided further, this bond is made and entered into for the protection of all claimants supplying labor and material in the prosecution of the work provided for in said Contract, and all such claimants shall have a direct right of action under the bond as provided in Chapter 2253 of the Texas Government Code as amended 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 above bounden parties have executed this instrument under their several seals this

_____ day of _____in the year 20 _____, the name and corporate seals of each corporate party being hereto affixed, and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

ATTEST: (Notary Seal)

By: _____
(notary signature)

_____
(notary name printed) (notary expiration date)

PRINCIPAL

By: _____
(original signature)

_____
(name and title printed)

SURETY'S

By: _____
(original signature)

_____
(name and title printed)

SURETY HOME OFFICE SERVICING AGENT

_____
(name)

_____
(title)

_____
(address)

_____

_____
(Telephone)

CERTIFICATION AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the _____ secretary of the Corporation named as Principal within the Performance & Payment bond; that _____, who signed the said bond on behalf of the Principal, was then _____ of said corporation; that I know that person's signature thereon to be genuine; and that said bond was duly signed, sealed and attested for and in behalf of said Corporation by authority of its governing body.

(CORPORATE SEAL)

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

TABLE OF CONTENTS

ARTICLE 1 CONTRACT DEFINITIONS
1.1 Contract Documents
1.2 Owner
1.3 Architect/Engineer
1.4 Contractor
1.5 Subcontractor
1.6 Project
1.7 Work
1.8 Day
1.9 Contract Sum
1.10 Substantial Completion
1.11 Pre-Final Inspection
1.12 Final Inspection
1.13 Contract Time
1.14 The Drawings
1.15 The Specifications
1.16 The Project Manual
1.17 Sub-subcontractor

ARTICLE 2 LAWS GOVERNING CONSTRUCTION
2.1 Compliance with Laws
2.2 Wage Rates
2.3 State Sales and Use Taxes
2.4 Antitrust Claims

ARTICLE 3 CONTRACT DOCUMENTS AND BONDS
3.1 Copies Furnished
3.2 Ownership of Contract Documents
3.3 Contract Documents at the Site
3.4 Record Documents
3.5 Performance and Payment Bonds
3.6 Interrelation of Contract Documents
3.7 Tax ID Form

ARTICLE 4 CONTRACT ADMINISTRATION
4.1 General Administration
4.2 Subcontracts
4.3 Access to and Inspection of the Work
4.4 Separate Contracts
4.5 Contract Termination
4.6 Written Notice
4.7 Disputed Matters

ARTICLE 5 CONTRACT RESPONSIBILITIES
5.1 Owner's Responsibilities
5.2 Owner-Contractor Obligations
5.3 Contractor's Responsibilities

5.4 Contractor's Superintendent
5.5 Acts and Omissions
5.6 Conditions at Site or Building
5.7 Insurance
5.8 Safety Precautions and Emergencies
5.9 Materials and Workmanship
5.10 Tests
5.11 Removal of Defective Work
5.12 Royalties and Patents
5.13 Equivalent Materials
5.14 Technical Submittals
5.15 Cleaning

ARTICLE 6 CONTRACT CHANGES
6.1 Change Orders
6.2 Unit Prices
6.3 Claims for Additional Costs
6.4 Claims for Additional Time
6.5 Minor Changes
6.6 Bar to Claims
6.7 Administrative Procedures for Change Orders

ARTICLE 7 CONTRACT PAYMENTS
7.1 Schedule of Values
7.2 Progress Payments
7.3 Claims for Unpaid Labor and Materials

ARTICLE 8 CONTRACT COMPLETION TIME
8.1 Notice to Proceed
8.2 Construction Schedule
8.3 Delays and Extension of Time
8.4 Completion of Work
8.5 Failure to Complete Work on Time

ARTICLE 9 CONTRACT SUBSTANTIAL COMPLETION
9.1 Certification
9.2 Date of Substantial Completion
9.3 Additional Inspection Costs

ARTICLE 10 CONTRACT FINAL ACCEPTANCE AND PAYMENT
10.1 Notification
10.2 Final Payment Documentation
10.3 Final Payment

ARTICLE 11 CONTRACT CORRECTION PERIOD
11.1 One Year Contract Correction Period
11.2 Remedy of Defects Under Warranty

ARTICLE 12 OPERATION AND STORAGE AREAS
12.1 Contractor's Use of Premises
12.2 Contractor's Maintenance of Premises

ARTICLE 1

CONTRACT DEFINITIONS

Whenever the following terms are used in these General Conditions or in the other Contract Documents the intent and meaning shall be interpreted as follows:

1.1 Contract Documents: The Contract Documents consist of the Advertisement for Sealed Proposals, Instructions to Proposers, Proposal Security, Proposal Form, Felony Conviction Notice, Affidavit of Non-collusion, Certificate of Residency, fully executed Owner-Contractor Agreement, Performance Bond, Payment Bond, the Conditions of the Contract (General, Supplementary, Special and other Conditions), the Project Manual, the Drawings, Pre-Proposal Meeting Minutes, all Addenda issued prior to execution of the Contract, other documents listed in the Owner-Contractor Agreement, and all Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by the Owner and the Contractor, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect.

1.1.1 The Contract Documents form the Contract, which represents the entire and integrated agreement between the Owner and the Contractor and supersedes all prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Architect and the Contractor, (2) between the Owner and a Subcontractor or Sub-subcontractor, (3) between the Owner and Architect or (4) between any person or entities other than the Owner and the Contractor.

1.1.2 The Contract Documents are complementary, and what is required by any one document shall be as binding as if required by all.

1.2 Owner: The Board of Trustees of the Galena Park Independent School District, who shall execute this Contract in the name of the School District, and who, along with certain designated administrative employees, shall be responsible for the administration of the Contract.

1.3 Architect/Engineer: An Architect registered in accordance with Occupation Code, Title 6, Chapter 1051 and/ or a professional Engineer, in accordance with Occupations Code 1001.057. Contract Documents by the Architect are limited in authority and responsibility as defined in the General Conditions.

1.4 Contractor: The individual, corporation, company, partnership, firm or other organization that has contracted to perform the Work under the Contract with the Owner.

1.5 Subcontractor: A person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. There shall be no direct contractual relationship between the Owner and any Subcontractor.

1.6 Project: All of the Work defined by the Contract Documents. 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 or by separate contractors.

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

1.8 Day: A calendar day beginning and ending at 12:00 midnight, unless otherwise specifically stipulated.

1.9 Contract Sum: The total compensation payable to the Contractor for performing the Work as originally contracted for, or as subsequently adjusted by Change Order or other Contract Modification.

1.10 Substantial Completion: Jointly certified by the Architect/Engineer, Owner and Contractor as the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents, and approvals from regulatory agencies have been received, so that the Owner can occupy or utilize the Work or the designated portion thereof for its intended use. This includes a fully-operational HVAC system with controls, security system, fire alarm system and PA system.

1.11 Pre-Final Inspection: The inspection conducted to determine that a Project or a portion thereof, is substantially complete.

1.12 Final Inspection: The inspection conducted to determine that all deficiencies found in the Pre-Final Inspection, or subsequently discovered, have been corrected and that it is appropriate to release retainage and/or make final payment.

1.13 Contract Time: Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, from the Notice to Proceed to Substantial Completion.

1.14 The Drawings: 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.

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

1.16 The Project Manual: A volume assembled for the Work which may include the bidding requirements, sample forms, Conditions of the Contract and Specifications.

1.17 Sub-subcontractor: A person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site.

ARTICLE 2

LAWS GOVERNING CONSTRUCTION

2.1 Compliance with Laws: In the performance of the Work, the Contractor shall comply with all applicable State and Federal laws including, but not limited to, laws concerned with labor, equal employment opportunity, safety, criminal history review, and minimum wages. The Contractor shall become familiar with, and at all times shall comply with and give notices required by all Federal, State and Local laws, ordinances, rules, regulations and lawful orders of public authorities which in any manner affect the performance of the Work, and shall indemnify and save harmless the Owner and its official representatives against any claim arising from violation of any such law, ordinance or regulation by the Contractor or by the Contractor's Subcontractors or employees. When requested, competent evidence of compliance with applicable laws shall be furnished.

2.1.1 The Contractor shall cooperate with city or other governmental officials at all times where their jurisdiction prevails. The Contractor shall secure and pay for all permits and governmental fees, licenses and inspections necessary for proper execution and completion of the Work which are customarily secured after execution of the Contract and which are legally required when proposals are received or negotiations are concluded.

2.1.2 Where the Underwriters' Laboratories have established standards and issued labels for a particular group, class, or type of equipment the Underwriters' Laboratories label shall be required on all equipment in that category.

2.1.3 These Contract Documents shall be governed and interpreted in accordance with the laws of the State of Texas, and shall be performable in Harris County, Texas.

2.2 Wage Rates: The Contractor is required to pay not less than the wage scale of the various classes of labor as shown on the "Prevailing Wage Rate Schedule" in the Supplementary Conditions to the General Conditions of the Contract provided by the Owner. The specified wage rates are minimum rates only, and the Owner will not consider any claims for additional compensation made by any Contractor because of payment by the Contractor of any wage rates in excess of the applicable minimum rate contained in the Contract Documents.

2.2.1 Pursuant to the provisions of Chapter 2258 of the Texas Government Code, the Contractor shall forfeit as a penalty to the Galena Park Independent School District sixty dollars ($60.00) for each laborer, workman or mechanic employed, for each calendar day, or portion thereof, such laborer, workman or mechanic is paid less than the stipulated minimum rates for any Work done under the Contract by the Contractor or by a Subcontractor or Sub-subcontractor under the Contractor.

2.2.2 The Contractor is responsible for compliance with the prevailing wage laws in accordance with the Owner's Prevailing Wage Rate Schedule and associated Standard Job Classifications. The Owner reserves the right to conduct on-site interviews with construction workers in order to verify compliance.

2.2.3 All workers shall be classified in one of the job classifications in the Prevailing Wage Rate Schedule. The Contractor shall notify each worker commencing work on the Project of the worker's job classification and the established wage rate required to be paid. The notice must be delivered in writing to the employee, with copies to the Owner, and must list both monetary wages and fringe benefits to be paid for each classification in which the worker is assigned duties.

2.2.4 Competent evidence of compliance with the applicable laws and the Owner's Prevailing Wage Rate Schedule shall be furnished by the Contractor in the form of certified payroll reports submitted monthly in a form acceptable to the Owner.

2.2.5 The Contractor shall post the Prevailing Wage Rate Schedule at the Project construction site in a conspicuous location and maintain the posting throughout the construction period to ensure that all workers have access to wage rate information.

2.3 State Sales and Use Taxes: The Owner qualifies for exemption from state and local sales and use taxes pursuant to the provisions of the Texas Limited Sales, Excise and Use Tax Act (Taxation - General, Article 20.04, Vernon's Texas Civil Statutes). The Contractor shall claim exemption from payment of applicable State taxes by complying with such procedures as may be prescribed by the State Comptroller of Public Accounts. The Owner shall forward an executed copy of the GPISD Tax Exemption Certificate with the fully executed Owner/Contractor Agreement.

2.4 Antitrust Claims: The Contractor shall assign to 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. Secs. 1 et seq (1973).

ARTICLE 3

CONTRACT DOCUMENTS AND BONDS

3.1 Copies Furnished: Drawings and the Project Manual: Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, such copies of the Drawings and the Project Manual as are reasonably necessary for execution of the Work.

3.2 Ownership of Contract Documents: All Contract Documents and copies thereof furnished by the Owner are and shall remain property of the Owner. In making copies of the Documents available the Owner does so only for the purpose of prosecution of the Work and does not confer a license or grant permission for any other use of the Documents. They are not to be used on any other Project and, with the exception of one Contract set for each party to the Contract, are to be returned to the Owner upon request following completion of the Work.

3.3 Contract Documents at the Site: The Contractor shall maintain in good order at the site one complete copy of all Contract Documents including Drawings, Project Manual, Addenda, Change Orders and other Contract Modifications, as well as a complete file of reviewed shop drawings and other technical submittals. The Contractor shall at all times give the Owner or its representatives and agents access thereto.

3.4 Record Documents: The Owner shall furnish to Contractor one set of "Xerox" Construction Drawings for the purpose of Record Documents. The Contractor shall maintain Record Documents and technical submittals (including shop drawings) which are marked to reflect the as-constructed conditions and representations of the Work performed, whether it be directed by Addendum, Change Order or other Contract Modifications. The as-constructed Record Documents and technical submittals shall also record accurately and dimensionally the locations of concealed elements of construction which are not specifically and dimensionally located in the original Contract Documents, particularly piping and equipment for utility, mechanical, electrical, plumbing and special systems. All records prescribed herein shall be made available for reference and examination by the Owner and its representatives and agents. The Contractor shall update the as-constructed Record Documents monthly prior to submission of periodic Applications for Payment. Failure to maintain such records shall constitute cause for denial of an Application for Payment otherwise due. Prior to the date of Substantial Completion, the Contractor shall deliver to the Architect/Engineer one complete set of as-constructed Record Documents which the Architect/Engineer shall review and (if found acceptable) shall then use in preparing final electronic Record Documents for the Owner.

The Contractor shall submit the Galena Park ISD Subcontractor Progress Assessment Form with each application for payment requesting payment be made for Work performed by a subcontractor that qualifies as a "small business" pursuant to GPISD Board Policy CV (Local). The Contractor shall also ensure that, once Contractor makes the applicable payment to the Small Business Subcontractor, the Subcontractor completes the Galena Park ISD Subcontractor(s)/Subcontractor(s) Supplier(s) Payment Certification Form in its entirety and Contractor agrees to submit the completed copies to Owner with the next application for payment. The completed Galena Park ISD Subcontractor(s)/Subcontractor(s) Supplier(s) Payment Certification Form must be received by the Owner before any further payment will be made to Contractor for any Work performed.

3.5 Performance and Payment Bonds: Performance and Payment Bonds are not required on contracts of less than $25,000.00. If the total Contract Sum equals or exceeds $25,000.00, then the Contractor shall execute (in accordance with the provisions of Section 2253.021 of the Government Code) the following bonds to the Owner: (1) Performance Bond in the amount of the total Contract Sum conditioned upon the faithful performance of the Contract. Said bond shall be solely for the protection of the Owner. (2) Payment Bond in the amount of the total Contract Sum solely for the protection of those supplying labor, materials and/or equipment in

the prosecution of the Contract. Additional requirements and instructions for preparation and submittal of Performance and Payment Bonds may be stipulated elsewhere in the Contract Documents.

3.5.1 Each bond shall be executed by a corporate surety or corporate sureties duly authorized to do business in the State of Texas, acceptable to the Owner, and on forms provided by the Owner. If any surety upon any bond furnished in connection with the Contract becomes insolvent, or otherwise not authorized to do business in this State, then the Contractor shall promptly furnish equivalent security to protect the interests of the Owner and of persons supplying labor, materials, and/or equipment in the prosecution of the Work contemplated by the Contract.

3.5.2 Each bond shall be accompanied by a valid Power-of-Attorney (issued by the surety company and attached, signed and sealed with the corporate embossed seal) authorizing the agent who signs the bond to commit the company to the terms of the bond, and stating (on the face of the Power-of-Attorney) the limit, if any, in the total amount for which the agent is empowered to issue a single bond.

3.6 Interrelation of Contract Documents: The interrelation of the Drawings and the Project Manual is as follows: The Project Manual establishes standards of design, quality, function and performance of several materials; the Drawings establish the locations, quantities, dimensions and details. Anything mentioned in the Project Manual and not shown on the Drawings, or shown on the Drawings and not mentioned in the Project Manual, shall be of like effect as if shown or mentioned on both.

3.6.1 Should the Drawings disagree one with another, or with the Project Manual, the better quality or greater quantity of Work or materials shall be performed or furnished. Figures and measurements given on larger scale drawings shall govern smaller scale drawings. In case of discrepancy either in the figures, in the Drawings, or in the Project Manual, the matter shall be promptly submitted in writing by the Contractor to the Architect/Engineer with a copy to the Owner. The Architect/Engineer shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at the Contractor's own risk and expense.

3.6.2 Any "Scope of Work" or "Work Included" statement placed in a Section of the Project Manual is intended to designate in general terms the types of Work to be performed. It is not intended to limit or to define the extent of the Work.

3.6.3 The location or grouping of Drawings and the placement of the Project Manual into Divisions and Sections is only for the convenience of referencing and relating like or similar types of Work. It is not intended to establish trade jurisdictions or to define or limit Work to be subcontracted. The prosecution and completion of all Work required by the Contract Documents is the responsibility of the Contractor.

3.7 Tax ID Form: Contractor shall provide to the Owner a copy of the executed notification of Tax ID Form W-9 prior to submitting the first Application for Payment.

ARTICLE 4

CONTRACT ADMINISTRATION

4.1 General Administration: Unless otherwise provided for in the Contract Documents, the Architect/Engineer will provide general administration of the Contract and will be the Owner's representative during construction and until final payment.

4.1.1 The Owner assumes no responsibility for any understanding given or representation made orally by its agents prior to the execution of this Contract, unless such understanding or representation is expressly stated in the Contract. The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor. Any failure by the Contractor to become acquainted with available information will not relieve the Contractor from responsibility for properly estimating the difficulty or cost of successfully performing the Work or mutually agreed changes thereto.

4.1.2 The Architect/Engineer has the authority to act on behalf of the Owner to the extent provided for in the Contract Documents, unless otherwise modified by written instrument which will be shown to the Contractor. The Architect/Engineer will advise and consult with the Owner.

4.1.3 The Owner's written instructions to the Contractor will generally be issued through the Architect/Engineer, except that the Owner reserves the right on appropriate occasions to issue instructions directly to the Contractor or through other designated representatives. All written communications concerned with the construction of the Project shall be furnished to the Owner, the Owner's designated agents and representatives, the Architect/Engineer, and the Contractor by the party originating the communication. All oral messages to or from the Contractor shall be given through the Owner's designated representative. The Contractor is responsible for complying with the Owner's administrative requirements set forth in these General

Conditions and stated elsewhere in the Contract Documents.

4.1.4 All oral instructions affecting Contract Sum, Contract Time or Contract interpretation, shall be confirmed promptly in writing with copies furnished to the Architect/Engineer, the Owner's designated representatives, and the Contractor by the party issuing the instruction.

4.1.5 No instructions affecting the Architect/Engineer's design liability shall be issued without the Architect/Engineer's prior written consent.

4.1.6 The Owner's representative, and the Architect/ Engineer with the Owner's consent, shall interpret the Contract requirements and have the authority to reject Work performed by the Contractor, which in the opinion of the Owner's representative or the Architect /Engineer does not meet the requirements of the Contract and to order such Work removed and replaced in accordance with paragraph 5. 11.

4.2 Subcontracts: The Contractor agrees to bind every Subcontractor and every Subcontractor agrees to be bound by the terms, conditions and requirements of the Contract Documents. Further, the Contractor shall fully inform all Subcontractors prior to executing an agreement with them that they will be required to perform their Work in conformance with the Contract Documents, and to submit cost estimates and change proposal requests in complete and full analytical detail per Paragraph 6.7.

4.2.1 The Contractor shall defend, indemnify and save harmless the Owner for any Subcontractor's claim which may result from the failure of the Contractor to incorporate the provisions of this Contract into any of the Contractor's subcontracts.

4.2.2 After the execution of the Contract, a change in any accepted Subcontractor or the addition of any new Subcontractor can only be made with the written consent of the Owner.

4.2.3 Re: Pre-Approved Sub-Contractors per the Supplementary Conditions.

4.3 Access to and Inspection of the Work: The Contractor shall provide sufficient, safe and proper facilities at all reasonable times for observation and/or inspection of the Work by authorized representatives of the Owner. The Architect/Engineer and the Owner will make periodic visits to the site to familiarize themselves with the progress and quality of the Work and to determine if the Work is proceeding in accordance with the Contract Documents. The presence of the Owner or his representative at the Project site does not imply concurrence with or approval of the Work.

4.4 Separate Contracts: The Owner reserves the right to award other Contracts in connection with other portions of the Project under these or similar conditions of the Contract.

4.4.1 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 signs each separate Owner-Contractor Agreement. The Contractor for this Contract shall properly connect and coordinate the Work of this Contract with the Work of other Contractors. If any part of this Contractor's Work depends on proper execution or proper results on the Work of any other separate Contractor, this Contractor shall inspect and promptly report in writing to the Architect/Engineer any discrepancies or defects which the Contractor may find in such other Work that render it unsuitable for such proper execution or results. Failure of this Contractor to so inspect and report shall constitute an acceptance of the other Contractor's Work as fit and proper to receive the Work of this Contract, except as to defects which may develop in the other separate Contractor's Work after the execution of this Contractor's Work.

4.4.2 Should this Contractor cause delay or cause damage to the Work or property of any separate Contractor on the Project, this Contractor shall, upon due notice, endeavor to settle with such other Contractor by agreement. If such separate Contractor sues the Owner on account of any damage alleged to have been so sustained, then the Owner shall notify this Contractor who shall defend such proceedings and pay all costs in connection therewith and, if any judgment against the Owner arises there from, this Contractor shall pay or satisfy it.

4.4.3 This Contractor shall afford the Owner and/or other contractors reasonable opportunity for the introduction and storage of their materials and equipment, and for the execution of their Work, and for proper connection to and coordination with this Contractor's Work.

4.4.4 The Owner reserves the right to make essential installations which are pertinent to the use of the building or Project prior to Substantial Completion. Within this right the Owner may let other Contracts or may do such Work with its own labor forces and materials. The Contractor shall not commit or permit any act which will interfere with the performance of Work by any other Contractor or supplier, or by Owner's employees. The Contractor shall cooperate to the end that the Owner may

realize complete functioning of the building or Project on the day of Substantial Completion.

4.5 Contract Termination:

4.5.1 Termination by Contractor. If the Work is stopped for a period of ninety (90) days under an order of any court or other public authority having jurisdiction, or as a result of an act of government, such as a declaration of a national emergency making materials unavailable, through no act of fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing any of the Work under a Contract with the Contractor, then the Contractor may, upon ten (10) additional days written notice to the Owner and the Architect/Engineer, terminate the Contract and recover from the Owner payment for all Work executed and for any loss sustained upon any materials, equipment, tools, construction equipment and machinery, including reasonable profit and overhead associated with such Work for losses and reasonable expenses resulting from such termination. If the cause of the Work stoppage is removed prior to the end of the ten (10) day notice period, the Contractor may not terminate the Contract.

4.5.2 Termination by Owner. If the Owner determines that the Contractor is adjudged as bankrupt, or if the Contractor makes a general assignment for the benefit of the Contractor's creditors, or if a receiver is appointed on account of the Contractor's insolvency, or if the Contractor persistently or repeatedly refuses or fails (except in cases for which extension of time is provided) to supply enough properly skilled workmen or proper materials, or if the Contractor persistently performs substandard Work, or persistently disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, or is otherwise guilty of a substantial violation of a provision of the Contract Documents, or fails to so prosecute the Work as to insure its completion (within the time, or any extension thereof, specified in this Contract), then the Owner may, without prejudice to any right or remedy, and after giving the Contractor and the Contractor's surety (if any) ten (10) days written notice, terminate the employment of the Contractor and take possession of the site and of all materials, equipment, tools, construction equipment and machinery thereon owned by the Contractor. Should the surety fail to respond within fifteen (15) days following such notice and to pursue completion of the Work with diligence acceptable to the Owner, the Owner may arrange for completion of the Work and deduct the cost thereof from the unpaid balance of the Contract Sum, including the cost of additional Architect/Engineer services and Owner Contract administration costs made necessary by such default or neglect, in which event no further payment shall then be made by the Owner until all costs of completing the Work shall have been paid. If the unpaid balance of the Contract Sum exceeds the costs of finishing the Work, including compensation for the

Architect/Engineer's additional services made necessary thereby, then such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, then the Contractor or the Contractor's surety shall pay the difference to the Owner. If the Owner sues the Contractor or Surety on account of failure to pay such difference in cost upon demand, then the Contractor and Surety will pay all costs in connection therewith, including reasonable attorney's fees. This obligation for payment shall survive the termination of the Contract.

4.5.3 Termination for Convenience of Owner: Prior to or during the performance of the Work, the Owner reserves the right to terminate the Contract for convenience or unforeseen causes that may occur. Upon such occurrence, the following procedures will be adhered to:

4.5.3.1 The Owner will immediately notify the Architect/Engineer and the Contractor in writing, specifying the effective termination date of the Contract.

4.5.3.2 After receipt of the notice of termination, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due at that point in the Contract.

.1 Stop all Work.
.2 Place no further subcontracts or orders for materials or services.
.3 Terminate all existing subcontracts.
.4 Cancel all existing materials and equipment orders as applicable.
.5 Take all actions necessary to protect and preserve all property related to this Contract which is in the possession of the Contractor.

4.5.3.3 Within 180 days of the date of the notice of termination, the Contractor shall submit a final termination settlement proposal to the Owner based upon costs up to the date of termination, reasonable profit on Work done only, and reasonable demobilization costs. If the Contractor fails to submit the proposal within the time allowed, then the Owner may determine the settlement amount, and shall pay the determined amount to the Contractor.

4.5.3.4 If the Contractor and the Owner fail to agree on the settlement amount, then the matter will be handled as a dispute in accordance with the procedure described in Subparagraph 5.2.1.

4.6 Written Notice: Written notice shall be considered to have been duly given if delivered in person to the individual or member of the firm or to an officer of the corporation for whom it is intended, or if delivered to, or sent by registered or certified mail to, the last business address known to the one who gives the notice.

4.7 Disputed Matters: Disputed matters shall be handled through administrative procedures as established in Subparagraph 5.2.1.

ARTICLE 5

CONTRACT RESPONSIBILITIES

5.1 Owner's Responsibilities: The Owner shall furnish all surveys describing the physical characteristics, legal description and limitations, site utility locations and other information necessary to the Contractor which are under the Owner's control.

5.1.1 Communication with the Contractor shall be in accordance with Paragraph 4.1.

5.1.2 Necessary actions of the Owner, including processing of payments to the Contractor, shall be accomplished with reasonable promptness and subject to Government Code, Chapter 2251, Subchapter B.

5.2 Owner-Contractor Obligations: The Owner and the Contractor each bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to the partners, successors, assigns and legal representatives of such other party in respect to all covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract or sublet it as a whole without the written consent of the Owner, nor shall the Contractor assign any moneys due, or to become due hereunder, without the previous written consent of the Owner.

5.2.1 Disputes: Except as otherwise provided in this Contract, any dispute concerning a question of fact arising under this Contract, which is not disposed of by the Owner-Contractor Agreement, shall be decided by the Owner (as represented by the Assistant Superintendent for Support Services) who shall reduce a decision to writing and mail or otherwise furnish a copy thereof to the Contractor. The decision of the Owner shall be final and conclusive unless, within 30 days from the date of receipt of such written decision, the Contractor mails or otherwise furnishes to the Owner a written appeal addressed to the Superintendent, Galena Park Independent School District. If the decision on the appeal is adverse, then the Contractor may, within 30 days from the receipt of such decision, make further appeal to the Board of Trustees of the Galena Park Independent School District whose decision shall be final and conclusive. In connection with any appeal under this Subparagraph, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of the Contractor's appeal to a person or persons appointed by the Board of Trustees for such purpose. Pending final decision of a dispute hereunder, the Contractor shall proceed diligently with the performance of the Contract and in accordance with the Owner's decision. Both parties agree that any decision of fact reached by the process in this Subparagraph 5.2.1 shall be contractually binding upon them and shall become a part of this Contract.

5.3 Contractor's Responsibilities: The Contractor shall supervise, coordinate and direct the Work using the Contractor's best skill and attention to assure that each element of the Work conforms to the requirements of the Contract Documents. The Contractor shall be solely responsible for and have control over all construction means, methods, techniques, safety, sequences and procedures, and for coordinating all portions of the Work under the Contract.

5.3.1 The Contractor is obligated to notify the Architect/Engineer, in writing, when 1) the Contractor is in disagreement with any items, details, methods, or specifications, or 2) if the Contractor has reason and can provide evidence that an element of the Work will not function properly or safely, or will not deliver appropriate service and durability if such item is provided in accordance with the Contract Documents. Such matters will be clarified in writing by the Architect/Engineer prior to their incorporation into the Project.

5.3.2 The Contractor's Superintendent shall prepare daily reports indicating all work in progress, listing all Subcontractors and crews working on site, and listing all material and equipment delivered to site. Provide copies of daily reports to Owner at progress meetings.

5.4 Contractor's Superintendent: The Contractor shall employ a competent Superintendent and necessary assistants who shall be in attendance at the Project site from the Notice to Proceed to completion of all punch list items attached to the Certificate of Substantial Completion. The Superintendent shall not be a foreman working on the Project; shall be an individual satisfactory to the Owner; and shall not be changed without the written approval of the Owner (except if the Superintendent leaves the employment of the Contractor). The Superintendent shall represent the Contractor and shall have full authority to act on the Contractor's behalf. All communications given to the
Superintendent shall be as binding as if given to the Contractor.

5.5 Acts and Omissions: The Contractor shall be responsible for acts and omissions of the Contractor's employees, of the Contractor's Subcontractors, their agents and employees and of other persons or entities performing portions of the Work for or on behalf of the Contractor or any of its Subcontractors. . The Owner may, in writing, require the Contractor to remove from the Work any employee that the Owner's designated representative or agent finds careless, incompetent or otherwise objectionable.

5.6 Conditions at Site or Building: The Owner makes no representations as to the accuracy or completeness of the site information furnished to the Contractor by Owner; does not expressly or impliedly warrant same; and is not responsible for any interpretations or conclusions reached by the Contractor with respect thereto. It is the Contractor's sole responsibility to verify (to the Contractor's own satisfaction) all site information including, but not restricted to, topographical data, borings, subsurface information, utilities and easements.

5.6.1 The Contractor is responsible for having visited the site and having ascertained pertinent local conditions such as locations, accessibility, and general character of the site or building, the character and extent of existing Work within and adjacent to the site, and any other Work being performed thereon. Any failure to do so will not relieve the Contractor from responsibility for successfully performing the Work without additional expense to the Owner.

5.6.2 If, in the performance of the Contract, concealed, subsurface or latent conditions at the site are found to be materially different from the information included in the proposed Contract Documents; or if unknown conditions of an unusual nature are discovered which differ materially from the conditions usually inherent in Work of the character shown and specified, then the Architect/Engineer shall be notified in writing of such conditions before they are disturbed. Upon such notice, or upon the Architect/Engineer's own observation of such conditions, the Architect/Engineer, with the approval of the Owner, will promptly make such changes in the Contract Documents as the Architect/Engineer deems necessary to conform to the different conditions. Any increase or decrease in the cost of the Work or in the time within which the Work is to be completed,
resulting from such changes will be adjusted by Change Order, subject to the prior approval of the Owner.

5.7 Insurance

5.7.1 The Contractor shall not commence any portion of the Work under this Contract until the Contractor has obtained all the insurance required hereunder and Certificates of Insurance and Policy have been filed with and reviewed by the Owner. Acceptance of the insurance certificates by the Owner shall not relieve or decrease the liability of the Contractor.

.1 This section shall govern the entire Contract.

.2 The insurance shall contain a provision that at least thirty days prior written notice shall be given to the Owner in the event of cancellation, material change or non-renewal.

.3 Insurance shall be underwritten by a company rated not less than B + VII in Best's latest published guide.

.4 There shall be a hold harmless agreement in which the Contractor assumes liability on the Contract and holds the School District harmless.

.5 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.

5.7.2 Casualty Insurance - Unless otherwise provided for in the Supplementary Conditions, the Contractor shall provide and maintain (until the Work covered in this Contract is completed and accepted by the Owner) the minimum insurance coverages as follows:

.1 Workmen's Compensation shall be furnished for all employees as follows:

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 is required for the duration of the Project.

Duration of the Project includes the time from the beginning of the Work on the Project until the Contractor's/person's Work on the Project has been completed and accepted by the governmental entity.

Persons providing services on the Project ("Subcontractor" in Texas Labor Code 406.096) include 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 contracted directly with the Contractor and regardless of whether that person has employees. This includes, without limitation, independent Contractors, Subcontractors, leasing companies, motor carriers,

owner-operators, employees of any such entity, or employees of any entity that furnishes persons to provide services on the Project.

Services include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a Project. Services do not include activities unrelated to the Project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

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.

The Contractor must provide a certificate of coverage to the governmental entity prior to being awarded the Contract.

If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the Project, then the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing that coverage has been extended.

The Contractor shall obtain from each person providing services on a Project, and provide to the governmental entity:

1. 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 the Project; and
2. No later than seven 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.

The Contractor shall retain all required certificates of coverage for the duration of the Project and for one year thereafter.

The Contractor shall notify the governmental entity in writing by certified mail or personal delivery, within ten days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project.

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.

The Contractor shall contractually require each person with whom it contracts to provide services on a Project, to:

1. Provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code 401.011(44) for all of its employees providing services on the Project for the duration of the Project;
2. Provide to the Contractor, prior to that person beginning work on the Project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the Project for the duration of the Project;
3. Provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project.
4. Obtain from each other person with whom it contracts, and provide to the Contractor:
    a. A certificate of coverage, prior to the other person beginning work on the Project; and
    b. A new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
5. Retain all required certificates of coverage on file for the duration of the Project and for one year thereafter;
6. Notify the governmental entity in writing by certified mail or personal delivery, within ten days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project; and
7. Contractually require each person with whom it contracts to perform as required by items 1-6, with the certificates of coverage to be provided to the person for whom they are providing services.

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 a 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.

The Contractor's failure to comply with any of these provisions is a breach of Contract by the Contractor that 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.

The coverage requirement recited above does not apply to sole proprietors, partners, and corporate officers who are excluded from coverage in an insurance policy or certificate of authority to self-insure that is delivered, issued for delivery, or renewed on or after January 1, 1996. 28 TAC 110.110(i)

5.7.3 Commercial General Liability Insurance (Occurrence Basis Only)

5.7.3.1 The Owner shall be named additional insured on the Contractor's policy with waiver of subrogation as to the subject job.

5.7.3.2 Bodily injury and property damage:

1. Each Occurrence $1,000,000
2. General Aggregate $2,000,000
3. Products/Completed Operations
   a. Aggregate $1,000,000
4. Personal and Advertising Injury
   a. Occurrence $1,000,000
5. Fire Damage, Legal Liability
   a. Any One Fire $50,000
6. Medical Expenses
   a. Any One Person $5,000

5.7.4 Business (Commercial) Automobile Liability Insurance All Owned, Non-Owned, and Hired Coverage

1. Automobile Liability $l,000,000
2. The Owner shall be named additional insured on the Contractor's policy with waiver of subrogation as to the subject job.

5.7.5 Deletions and Exclusions

1. No deletions/exclusions from standard coverage forms shall be permitted, without the written consent of the Owner for Commercial General Liability Insurance or Business (Commercial) Automobile Liability Insurance.

5.7.6 Umbrella Liability Insurance

.1 Umbrella shall be issued as "Follow Form Policy".

.2 This policy shall provide coverage over the Workmen's Compensation, Commercial General Liability, and Business (Commercial) Automobile Liability (Covering All Owned, Non-Owned, and Hired Vehicles.)

5.7.7 Builder's Risk Insurance:

The Contractor shall obtain at the Contractor's expense, All Risk Property Insurance coverage, acceptable to the Owner, in the amount of insurance equal at all times to the insurable value of materials delivered and labor performed. The policy so issued in the name of the Contractor shall also name all Subcontractors and the Owner as additional insured, as their respective interests may appear. The policy shall have endorsements as follows: "This insurance shall be specific as to coverage and not considered as contributing insurance with any permanent insurance maintained on the present premises."

.1 The policy shall be written in the name of the Owner and Contractor as their interest may appear.
.2 The policy shall be written on all risk basis for physical loss or damage and include the vandalism, malicious mischief.
.3 The amount of coverage shall be for the full insurable value of Work.
.4 The deductible shall not be over $1,000.00 without approval of the Owner. (Deductible losses shall be paid by the Contractor.)
.5 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.
.6 The original Builder's Risk Policy shall be furnished to the Owner prior to start of the job. This shall be a "Stand Alone" Policy.
.7 The Policy shall include $500,000 extra expense.

5.8 Safety Precautions and Emergencies:

5.8.1 It shall be the duty and responsibility of the Contractor and all of its Subcontractors to be familiar and comply with all requirements of Public Law 91-596 enacted by Congress, December 29, 1970, cited as the Occupational Safety and Health Act of 1970, and all amendments thereto, commonly referred to as OSHA, and to enforce and comply with all of the provisions of this

Act. The Owner reserves the right to enforce standard safety practices through the Contractor, which shall take immediate action when notified either orally or written of an unsafe condition.

5.8.2 In any emergency affecting the safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Any additional compensation or extension of time claimed by the Contractor resulting from response to an emergency shall be considered in accordance with Article 6 - Contract Changes.

5.9 Materials and Workmanship: All Work shall be executed in accordance with the Contract Documents, complete in all parts and in accordance with approved practices and customs, and of the best finish and workmanship. Unless otherwise specified, all materials and equipment incorporated in the Work under the Contract shall be new.

5.10 Tests: If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to be inspected, tested or approved, the Contractor shall give the Owner and the Architect/Engineer timely notice of its readiness and of the date arranged so that the Architect/Engineer may observe such inspection, testing or approval.

5.10.1 The Owner shall pay for all routine testing of materials agreed by the Architect/Engineer and the Owner to be required by the Contract Documents or to be in the best interests of the Owner. When retesting of material failing the initial test is required, the cost of retesting will be paid for by the Contractor. Any special testing which is specifically required in the scope of Work and specifically stipulated to be the responsibility of the Contractor in a technical section of the Project Manual shall be paid for by the Contractor.

5.10.2 Should testing of suspected non-compliant material or Work require that completed Work be removed to accomplish the testing, and further should the testing demonstrate that the material or Work fails to comply with the requirements of the Contract Documents, the Contractor shall bear all costs of the testing, inspection or approval as well as the cost of replacement of unsatisfactory material or Work as provided by paragraph 5.11. Should the testing demonstrate that the Work or material is in compliance, the Owner shall bear such costs and an appropriate Change Order shall be issued.

5.10.3 Material compliance with the Contract Documents shall be made by one of the following:

1. Manufacturer's certificate of compliance.
2. Mill certificate.
3. Testing laboratory certification.
4. Report of actual laboratory test from the Owner's laboratory or from a laboratory satisfactory to the Owner. Samples tested shall be selected by or in the presence of the Owner and the method of testing shall comply with the professional societies' standard specifications.

5.11 Removal of Defective Work: The Owner's representatives and the Architect/Engineer shall interpret the Contract requirements and shall be the final judge of the acceptability of the Work under the Contract Documents.

5.11.1 If any materials furnished under this Contract are judged to be not in compliance with requirements of the Contract Documents by the Owner and/or the Architect/Engineer, then the Owner and/or the Architect/Engineer will deliver to the Contractor a notification of such non-compliance in writing. The Contractor shall, after having received such written notice of non-compliance, proceed to remove from the grounds or buildings all materials (whether worked or unworked) and to take down all portions of the Work which the Owner and/or Architect/Engineer shall by such written notice condemn as unsound or improper or as in any way failing to conform to the requirements of the Contract Documents; and shall make good all Work damaged or destroyed thereby.

5.11.2 The Contractor shall, without charge, replace any material or correct any workmanship found by the Owner or Architect/Engineer not to conform to the requirements of the Contract Documents, unless in the public interest the Owner consents in writing to accept such material or workmanship with an appropriate adjustment in the Contract Sum. The Contractor shall promptly correct all Work rejected by the Owner or Architect/Engineer as defective or as failing to conform to the Contract Documents whether observed before or after the date of Substantial Completion or Final Inspection and acceptance and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected Work.

5.11.3 If the Contractor does not promptly replace rejected material or correct rejected workmanship, the Owner may, 1) replace such materials or correct such workmanship and charge the cost thereof to the Contractor, or 2) terminate the Contractor's employment in accordance with Paragraph 4.5, Contract Termination.

5.11.4 If any portion of the Work is covered contrary to the instructions of the Owner or Architect/Engineer or to the requirements specifically expressed in the Contract

Documents, then it must be uncovered for observation or testing and recovered at the Contractor's expense without change in the Contract Time.

5.11.5 If any other portion of the Work is covered which the Owner or Architect/Engineer has not specifically requested to observe prior to being covered, then either may request to see such Work and it shall be uncovered by the Contractor. If such Work is found to be in accordance with the Contract Documents, then the cost of uncovering and recovering shall, by appropriate Change Order, be charged to the Owner. If such Work is found not to be in accordance with the Contract Documents, then the Contractor shall pay such costs.

5.12 Royalties Patents and Copyrights: The Contractor shall pay all royalties and license fees, and defend all suits or claims for infringement of any copyrights and patent rights; and shall save the Owner harmless from loss on account thereof, except that the Owner shall be responsible for all such royalties and license fees and loss when a particular design or process, or the product of a particular manufacturer or manufacturers is specified; provided, however, if the Contractor has reason to believe that the required design, process or product specified is an infringement of a copyright or a patent, then the Contractor shall be responsible for such royalties, license fees and loss unless the Contractor promptly gives information to the Owner and the Architect/Engineer.

5.13 Equivalent Materials: It is not the intent of these Contract Documents to limit materials to the product of any particular manufacturer. Where definite materials, equipment and/or fixtures have been specified by name, manufacturer or catalog number, it has been done to set a definite standard and a reference for comparison for quality, function, application, physical conformity, and other characteristics. It is not the intention to discriminate against or prevent any dealer, jobber or manufacturer from furnishing materials, equipment, and/or fixtures which meet or exceed the characteristics of the specified items as judged by the Owner and/or the Architect/Engineer. Substitution of materials shall not be made without prior written approval of the Owner and the Architect/Engineer.

5.13.1 The Contractor shall be responsible for any additional costs or delays resulting from having furnished materials, equipment or fixtures other than those specified or subsequently approved, and shall reimburse the Owner for any increased design costs resulting from such substitutions.

5.13.2 The Owner shall be the final judge of whether a proposed substitution meets or exceeds the characteristics of a specified item and decisions of the Owner relative to the equivalency of items proposed as substitutes for specified items shall be final and conclusive.

5.14 Technical Submittals:

5.14.1 Definition: Technical Submittals include Shop Drawings, Product Data, Installation Instructions, Samples, and other submittals which are typically related to construction materials, products, systems or services, and which are required by the Contract Documents.

5.14.1.1Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or any Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

5.14.1.2Product 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.

5.14.1.3Samples are physical examples furnished by the Contractor which illustrate materials, equipment or workmanship, and which establish standards by which the Work will be judged.

5.14.2 The Contractor shall submit within three (3) months after the date of the Notice to Proceed, and in orderly sequence, all Technical Submittals required by the Contract Documents, or subsequently required by the Architect/Engineer as covered by Contract modifications. The Contractor shall review them for compliance with Contract Documents and shall certify that the Contractor has done so by stamp, or otherwise, affixed to each copy thereof. Submittal data presented without such certification will be returned without review or other comment, and any delay resulting there from will be the Contractor's responsibility.

5.14.2.1The Contractor shall, within twenty (20) calendar days after receipt of the Notice to Proceed, submit to the Owner through the Architect/Engineer two (2) copies of a list of submittals, in a form acceptable to the Owner, which lists all Technical Submittals that are required by the Contract, and indicates which are to be reviewed and certified by the Contractor. The list shall then be reviewed and approved by the Owner and/or the Architect/Engineer.

5.14.2.1.1 The schedule shall include, but is not necessarily limited to, all Technical Submittals, certificates of compliance, material samples, material color charts or samples, guarantees, operation and

maintenance instructions, etc.

5.14.2.1.2 The schedule shall indicate the type of item, Contract requirements reference, the Contractor's scheduled dates for submitting the items, the projected need dates for approval from the Owner or the Architect/Engineer, and the projected or actual dates for procurement. The schedule shall show a minimum of fifteen (15) calendar days after receipt for review by the Owner and Architect/Engineer. If resubmittal is required, then an additional fifteen (15) days will be allowed for review after receipt. The Contractor will revise and/or update this schedule as appropriate, and submit same with each monthly Application for Payment.

5.14.2.1.3 The submittal schedule shall be coordinated with the Owner-reviewed, Contractor prepared and submitted construction schedule for all the Work. The Contractor shall revise and/or update the submittal schedule monthly to insure consistency with the construction schedule. The Owner shall be provided with two (2) copies of each revised submittal schedule.

5.14.3 Technical Submittals shall be properly identified, as specified or as the Owner and/or Architect/Engineer may require. At the time of submission, the Contractor shall inform the Owner and the Architect/Engineer in writing of any deviations in the Technical Submittals from the requirements of the Contract Documents.

5.14.4 By providing Technical Submittals, the Contractor thereby represents that the Contractor has determined and verified all field measurements, field construction criteria, materials, catalog numbers and similar data, or will do so; that the Contractor has checked and coordinated each Technical Submittal with the requirements of the Work and of the Contract Documents; and that the Contractor shall so certify as required by Subparagraph 5.14.2.

5.14.5 The Architect/Engineer and/or the Owner will review the Technical Submittals with reasonable promptness, but only for conformance with the design concept of the Project and with the information given in the Contract Documents. The review of a separate item shall not indicate approval of an assembly in which the item functions. Review of the Technical Submittals shall not relieve the Contractor of responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has informed the Owner and the Architect/Engineer in writing of such deviations at the time of submittal and the Owner or the Architect/Engineer has not objected to the specific deviations. The approval shall not relieve the Contractor from responsibility for errors or omissions in the Technical Submittals.

5.14.6 The Contractor shall make any corrections required and shall resubmit the required number of corrected copies of the Shop Drawings or Product Data or new Samples of materials until accepted. The Contractor shall direct specific attention in writing to any new revisions other than the corrections requested on previous submissions.

5.14.7 No Work requiring a Technical Submittal shall be performed until the submittal has been reviewed. All such Work shall be in accordance with the reviewed Technical Submittal.

5.15 Cleaning: The Contractor shall at all times keep the premises and surrounding area clean and free from accumulation of waste materials or rubbish caused by the Work under this Contract. Upon completion of the Project, and prior to the Final Inspection, the Contractor shall have the premises in a neat and clean condition.

ARTICLE 6

CONTRACT CHANGES

6.1 Change Orders: A Change Order is a written order to the Contractor signed by the Owner, the Contractor and the Architect/Engineer, and issued after execution of the Contract which authorizes a change in the Work or an adjustment in the Contract Time. The Contract Sum and the Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates the Contractor's agreement therewith, including the adjustment in the Contract Sum or the Contract Time. It is recognized by the parties hereto and agreed by them that the Contract Documents may or may not be complete, or be free from errors, omissions and imperfections, or require changes or additions in order for the Work to be completed to the satisfaction of Owner. Accordingly, it is the express intention of the parties (notwithstanding any other provisions in this Contract) that any errors, omissions or imperfections in the Contract Documents, or any changes in or additions to same or to the Work ordered by Owner and any resulting delays in the Work or increases in Contractor's costs and expenses, shall not constitute or give rise to any claim, demand or cause of action of any nature whatsoever in favor of Contractor, whether for breach of Contract, quantum merit, or otherwise. However, the Owner shall be liable to the Contractor for the sum stated to be due the Contractor in any Change Order approved and signed by all parties. It is agreed hereby that such sum, together with any extension of time contained in said Change Order, shall constitute full compensation to the Contractor for all costs, expenses and damages to the Contractor, whether direct, consequential or otherwise in any wise

incident to, arising out of, or resulting directly or indirectly from the Work performed by the Contractor under such Change Order.

6.1.1 The Owner, without invalidating the Contract and without approval of the Surety, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and the Contract Time being adjusted accordingly. All such changes in the Work shall be authorized by Change Order or Construction Change Directive and shall be performed under the applicable conditions of the Contract Documents.

6.1.1.1 Any other written order or oral order (which terms as used in this paragraph shall include direction, instruction, interpretation, or determination) from the Architect/Engineer or Owner shall be treated as a Change Order under this clause only if the Contractor gives the Owner written notice within twenty (20) days stating the date, circumstances, source of the order and that the Contractor regards the order to be a Change Order.

6.1.1.2 The Owner may, in writing, issue a Notice to Proceed for any portion of the Work in a Change Order for which final adjustment in Contract Sum and/or Contract Time has not been finalized. The Notice to Proceed letter may have a not-to-exceed cost amount for any or all portions of the Change Order. This amount is not to be exceeded without prior written approval by the Owner.

6.1.2 If the Contractor intends to assert a claim for an adjustment of cost or time over and above any adjustment already granted in a Change Order, then the Contractor must (within twenty (20) calendar days after receipt of a written Change Order, or receipt of oral or written order to proceed with a proposed change under Clause 6.1.1.2, or after the furnishing of a written notice under Clause 6.1.1.1) submit to the Owner a written statement setting forth in detail the nature and monetary extent of such claim as per Paragraph 6.3. The Contractor shall certify that the claim is made in good faith and that the supporting data is current, accurate and complete to the best of the Contractor's knowledge and belief, and that the amount requested accurately reflects the Contract adjustment for which the Contractor believes the Owner is liable. Failure to certify a claim will result in a determination that no claim has been filed. The thirty (30) day period of time for submission of such claim may be extended only by written agreement signed by the Owner. Except for claims based on defects in drawings or specifications furnished by the Owner, no claim for any change under Subparagraph
6.3.1 shall be allowed for any costs incurred more than twenty (20) days before the Contractor gives written notice as therein required; provided that, in the case of claims based on defects in drawings or specifications furnished by the Owner, the adjustment in cost shall include only those increased direct costs reasonably and necessarily incurred by the Contractor as a result of such defective drawings or specifications.

6.1.3 Except as provided above, no order, oral statement, or direction of the Owner or the Owner's duly appointed representative shall be treated as a change under this Article or entitle the Contractor to an adjustment thereunder.

6.1.4 The Contractor agrees that the Owner or any of its duly authorized representatives shall have access to and the right to examine any directly pertinent books, documents, papers, and records of the Contractor. Further, the Contractor agrees to include and submit evidence that all of its subcontracts include a provision to the effect that the Subcontractor agrees that the Owner or any of its duly authorized representatives shall have access to and the right to examine any directly pertinent books, documents, papers and records of such Subcontractor relating to any claim from the Contract, whether or not the Subcontractor is party to the claim. The period of access and examination described herein which relate to appeals under Subparagraph 5.2.1, litigation, or the settlement of claims arising out of the performance of this Contract shall continue until final disposition of such claims, appeals or litigation.

6.2 Unit Prices: If unit prices are stated in the Contract Documents or subsequently agreed upon, and if the quantities originally contemplated are so changed in a proposed Change Order or Construction Change Directive that application of the agreed unit prices to the quantities of Work proposed will cause substantial inequity to the Owner or the Contractor, then the applicable unit prices shall be equitably adjusted as provided herein.

6.2.1 Each unit price proposed by the Contractor shall include all costs applicable to the Work including, but not limited to, mobilization, demobilization, labor, materials, equipment, supervision, delays, overhead at any level, and profit.

6.2.2 Either party may request an equitable adjustment. The equitable adjustment shall be based upon any increase or decrease in costs due solely to the variation above one hundred and fifteen percent (115%) or below eighty-five percent (85%) of the originally specified amount. If the quantity variation causes an increase in the time necessary for completion, then the Owner (upon receipt of a written request for an extension of time within thirty (30) days from the recognition of the variation or

within such further period of time as may be granted by written agreement signed by the Owner) will ascertain the facts and make such adjustment for changing the completion date as in its judgment the findings justify.

6.3 Claims for Additional Costs:

6.3.1 If the Contractor wishes to make a claim for an increase in the Contract Sum, then the Contractor shall give the Owner and the Architect/Engineer written notice thereof within thirty (30) days after the occurrence of the event giving rise to such claim. This notice shall be given by the Contractor before proceeding to execute the Work, except in an emergency endangering life or property in which case the Contractor shall proceed in accordance with Subparagraph 5.8.2. No such claim shall be valid unless so made and the Contractor hereby waives all claims for which such notice is not given. If the Owner and the Contractor cannot agree on the amount of the adjustment in the Contract Sum, it shall be determined by administrative procedures as provided in Subparagraph 5.2.1. Any changes in the Contract Sum resulting from such claim shall be authorized by Change Order.

6.3.2 If the Contractor claims that additional cost is involved because of, but not limited to, (1) any written interpretation of the Contract Documents, (2) any order by the Owner to stop the Work pursuant to Subparagraph 4.5.3 where the Contractor was not at fault, (3) any written order for a minor change in the Work issued pursuant to Paragraph 6.5, then the Contractor shall make such claim as provided in Subparagraph 6.3.1 in a timely manner which will not have an effect on the construction schedule.

6.3.3 Any claim shall contain the following elements: (1) an analysis of the relevant Contract provisions, (2) a description of the facts, (3) a statement of why the particular facts warrant compensation under the terms of the Contract, (4) supporting cost or pricing data per Paragraph 6.7, (5) legal analysis, if appropriate, (6) expert opinion, if appropriate, (7) certification per Subparagraph 6.3.4**,** and (8) a formal request for decision. All direct costs should be accurately presented in the claim, i.e., labor should come from payrolls, equipment from equipment reporting forms and materials should be based on invoices.

6.3.4 The Contractor shall certify that the claim is made in good faith, that the supporting data is current, accurate and complete to the best of the Contractor's knowledge and belief, and that the amount requested accurately reflects the Contract adjustment for which the Contractor believes the Owner is liable.

6.3.5 Failure to certify the claim will result in a determination that no claim has been filed.

6.4 Claims for Additional Time: If a change in the Work causes an increase or decrease in the Contract Time, then the Contractor's proposal shall include a reasonable estimate of such increase or decrease based on effects of the Change Order to critical path activities. Any costs associated with a change in the Contract Time is included in the fifteen percent (15%) mark-up.

6.5 Minor Changes: The Architect/Engineer, with concurrence of the Owner, will have authority to order minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time. Such changes shall be effected by written order which the Contractor shall carry out promptly.

6.6 Bar to Claims: No claim shall be allowed for an adjustment under this or any other provision of the Contract if asserted after final payment under this Contract.

6.7 Administrative Procedures for Change Orders: If a change in the Work will result in an increase or decrease in the Contract Sum, then the Owner shall have the right to require the performance thereof on a lump sum basis, a unit price basis or a time and material basis, all as hereinafter more particularly described (the right of the Owner as aforesaid shall apply with respect to each such change in the Work).

6.7.1 Lump Sum Proposal: In responding to a request for a proposed price for a change in the Work, or in submitting a claim, the Contractor shall furnish a lump sum proposal supported by a complete breakdown as described hereafter, indicating the estimated or actual cost to the Contractor for performance of the changed Work, including the applicable percentage of overhead and profit described hereafter. Any request for a time extension must be justified and presented in adequate detail to permit evaluation per Article 8, showing that the proposed change will delay the final Contract Completion Date.

6.7.1.1 A Lump Sum Proposal for the adjustment of Work shall contain the following items:

.1 Estimated cost, using any discount to the trades, of the materials and supplies used, which shall be itemized completely to include unit cost, quantity and total cost.

.2 The portion of the proposal relating to labor, whether by the Contractor's forces or the forces of any of its Subcontractors or Sub-subcontractors, may include reasonably anticipated direct wages of jobsite labor

(including foremen) who will be directly involved in the change in the Work (for such time as they will be so involved). In addition to the direct wages, payroll costs including Social Security, Federal/State Unemployment Insurance and like taxes may also be included. These payroll costs shall be itemized separately; and the Contractor shall provide verifying documentation of these costs. Furthermore, any fringe benefits required by applicable union/trade agreements in connection with such direct wages may also be included if the Contractor provides verifying documentation of these benefits.

.3 Estimated cost to the Contractor for additional construction equipment used solely on the Change Order, to include rental rates or owned equipment rates for such items of equipment while in use, which shall be itemized completely to include type(s), the number(s) of each, hourly rate, hours and total cost. Equipment which is regularly used at the job shall be used in Change Order Work at no extra charge. Rental or owned equipment rates shall be no greater than those established by the Association of General Contractors for the local area. As used herein the terms "construction equipment" and "equipment" shall include wheeled vehicles and small tools.

.4 Estimated transportation costs for delivery and handling of materials and supplies, bringing to and removing from the site additional construction equipment and/or new items of installed equipment, if applicable, which shall be itemized separately.

.5 Estimated off-site storage costs in excess of thirty (30) calendar days for new items of installed equipment, if applicable.

.6 To the Contractor's, Subcontractor's or Sub-subcontractor's cost proposal for Work performed by its own forces, a markup of fifteen percent (15%) shall be added to cover all elements of overhead and profit including, but not limited to, supervision above the level of foremen, estimating, scheduling, procurement, cleanup, temporary facilities, consumables, safety, quality control/assurance, protection, security, small tools, radios, company vehicles, home and branch office costs and expenses of any type whatsoever. To the Contractor's cost proposal five percent (5%) shall be added to the Subcontractor's or Sub-subcontractor's cost proposal to cover processing and management of the added Work. If any of the items included in the lump sum proposal are covered by unit prices contained in the Contract Documents, then the Owner may, if it requires the change in the Work to be performed on a lump sum basis, elect to use these unit prices in lieu of the similar items included in the lump sum proposal. In this event an appropriate deduction will be made in the lump sum amount prior to the application of any allowed overhead and profit percentages. No overhead and profit shall be applied to any unit prices.

.7 To the summary of the Contractor's proposed cost, the direct cost for insurance and bonds shall be added upon the Contractor providing documentation.

6.7.2. In cases where changes in the Work result in a credit to the Owner, the credit shall be limited to direct costs; that is, no overhead or profit shall be applied to such costs. In cases where a change in the Work results in both credits and charges to the Owner, the Contractor will be allowed to add the overhead and profit percentages indicated in Clause 6.7.1.1 to the net charge based upon the amount by which the total charges exceed the total credits; if there is a net credit, then no overhead or profit shall be charged.

6.7.3 Time and Material Proposal: If the Owner elects to have the change in the Work performed on a time and material basis, the same shall be performed, whether by the Contractor's forces or the forces of its Subcontractors or Sub-subcontractors, at actual cost to the entity performing the change in the Work plus the same markups for overhead and profit as set forth in Clause 6.7.1.1. The Contractor shall submit to the Owner daily time and material tickets which shall include the identification number assigned to the change in the Work, the classification of labor employed (and names and social security numbers), the materials used, the equipment rented (not tools) and such other evidence of cost as the Owner may require. The Owner may require authentication of all time and material tickets and invoices by persons designated by the Owner for such purpose. The failure of the Contractor to secure any required authentication shall, if the Owner elects to treat it as such, constitute a waiver by the Contractor of any claim for the cost of that portion of the change in the Work covered by a non-authenticated ticket or invoice; provided, however, that the authentication of any such ticket or invoice by the Owner shall not constitute an acknowledgement by the Owner that the items thereon were reasonably required for the change in the Work.

6.7.4 Submission Time: Contractor's proposals for changes in the Contract Sum or Contract Time for Change Order Work shall be submitted within fourteen (14) calendar days of the Owner's or A/E's written request for same, unless the Owner or A/E extends such period of time due to the circumstances involved. If such proposals are not timely received, or if the changed Work should start immediately to avoid damage to the Project or to

avoid a delay, then the Owner may (at its discretion and in the interest of prosecuting the Work to timely completion) direct the Contractor to proceed with the changed Work. In this case the Owner shall direct the Contractor in writing to proceed with the Work on a time and material basis in compliance with Paragraph 6.7.3. This directive shall be known as a "PDL-NTE" (Price Determined Later - Not To Exceed). If such directive is given orally to the Contractor by the Owner under the above procedure, then the oral directive shall be confirmed in writing by the Contractor within seven (7) calendar days. The cost or credit and time adjustments will be determined through negotiation as soon as practicable thereafter and will be incorporated in a Change Order to the Contract. Prior to such negotiations, the Contractor shall keep separate costs on the "PDL-NTE" Work done up to that point.

6.7.5 Processing: The Owner will undertake to formally process Owner-Contractor agreed Change Orders with thirty (30) calendar days of agreement.

6.7.6 Construction Change Directive: If the Owner and the Contractor fail to agree on the terms of a Change Order, then the Owner shall issue through the Architect/Engineer a Construction Change Directive which is a written order directing a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum and/or Contract Time.

6.7.6.1 A Construction Change Directive may be issued before, during or after changed Work is accomplished, under the following conditions:

.1 The Contractor fails to submit a timely price and/or time extension proposal for the changed Work.

.2 Negotiation fails to achieve an agreed price and/or time extension, or there remains a disagreement concerning any part of the changed Work.

.3 Contractor fails or refuses to timely execute a Change Order by affixing the Contractor's signature thereto.

6.7.6.2 The terms of a Construction Change Directive including the change in Contract Sum and/or Contract Time shall be determined by the Owner with the assistance of the Architect/Engineer and shall, in the Owner's judgment, be fair and reasonable.

6.7.6.3 When a Construction Change Directive has been issued, it shall have the full force and effect of a Contract modification. It shall be included in schedules, Applications for Payment, reports and all official records of the Contract. The issuance of a Construction Change Directive will not prejudice any of the Contractor's rights to make claims or to appeal disputed matters under provisions of this Contract.

6.7.7 Notice to Proceed with Change Order Work: It is recognized that time is often of the essence in the execution of Change Order Work. Accordingly, the Owner may issue written notices to proceed with the Change Order Work while the formal Change Order is still being processed. The Contractor shall comply with these notices to proceed on the representation that formal confirming Change Orders will be issued.

ARTICLE 7

CONTRACT PAYMENTS

7.1 Schedule of Values: Upon execution of the Contract by the Owner and the Contractor, the Contractor shall submit for approval to the Owner and the Architect/Engineer a breakdown of the Contract Sum, itemizing material and labor for the various classifications of the Work. This Schedule of Values will be used as the basis for the Contractor's Applications for Payment.

7.1.1 No Application for Payment will be considered prior to receipt and approval of the Schedule of Values, which shall be in such detail as may be required by the Owner. The Schedule of Values shall be submitted to the Architect and Owner not less than twenty (20) days prior to the first Application for Payment, and this shall be a condition precedent to the processing of the first payment. The Schedule of Values shall follow the trade divisions of the Project Manual. Each item shall be assigned labor or material values, or both, with the subtotal thereof equaling the value of the Work in place when completed. Contractor's overhead and profit, mobilization, bond, and insurance shall each be listed as a separate line item on the Schedule of Values. The sum of all line items shall equal the Contract Sum.

7.1.2 The Contractor shall submit with the Schedule of Values a copy of all worksheets used in preparation of its proposal, supported by a notarized statement that the worksheets are true and complete copies of the documents used to prepare the proposal. The Contractor's proposal sheets shall be handled as confidential documents to the extent permitted by law.

7.2 Progress Payments: Payment will be made to the Contractor upon receipt of monthly Applications for Payment as provided hereinafter for the Work performed, and materials suitably stored and protected on the construction site. Progress payments do not constitute acceptance of Work not in accordance with the Contract Documents. Contractor shall provide a Department of the Treasury I.R.S. Form W-9 (latest edition) to the Owner prior to the first Application for Payment.

7.2.1 Once each calendar month, the Owner shall make a progress payment to the Contractor based upon an Application for Payment certified by the Architect/Engineer (for Work performed under this Contract during the preceding calendar month) which shall be accompanied by an affidavit that all payrolls, bills for labor, materials, equipment, or other indebtedness connected with such Work have been paid or will be paid within thirty (30) days after the Owner's receipt of the Application for Payment, or within the period of time required by Government Code, Chapter 2251, Subchapter B (see below), and a Certified Payroll (if specifically requested by Owner).

2251.021 Time for Payment by Governmental Entity.

a) Except as provided by Subsection b), a payment by a governmental entity under a Contract executed on or after September 1, 1987, is overdue on the 31st day after the later of:

1) the date the govern-mental entity receives the goods under the Contract;
2) the date the performance of the service under the Contract is completed; or
3) the date the govern-mental entity receives an invoice for the goods or services.

b) A payment under a Contract executed on or after September 1, 1993, owed by a political subdivision whose governing body meets only once a month or less frequently is overdue on the 46th day after the later event described by Subsections a)1) through 3).

c) For a Contract executed on or after July 1, 1986, and before September 1, 1987, a payment by a governmental entity under that Contract is overdue on the 46th day after the later event described by Subsections a)1) through 3).

Added by Acts 1993, 73rd Leg., ch. 268, 1, eff. Sept. 1, 1993. Amended by Acts 1995, 74th Leg., ch. 76, 5.42(a), eff. Sept. 1, 1995.

2251.022 Time for Payment by Vendor

a) A vendor who receives a payment from a governmental entity shall pay a Subcontractor the appropriate share of the payment not later than the 10th day after the date the vendor receives the payment.

b) The appropriate share is overdue on the 11th day after the date the vendor receives the payment.

Added by Acts 1993, 73rd Leg., ch. 268, 1, eff. Sept. 1, 1993.

2251.023 Time for Payment by Subcontractor

a) A Subcontractor who receives a payment from a vendor shall pay a person who supplies goods or a service for which the payment is made the appropriate share of the payment not later than the 10th day after the date the Subcontractor receives the payment.

b) The appropriate share is overdue on the 11th day after the date the Subcontractor receives the payment.

Added by Acts 1993, 73rd Leg., ch 268, 1, eff. Sept. 1, 1993.

7.2.2 To insure the proper performance of this Contract, the Owner shall retain not less than five percent (5%) of the amount of each Application for Payment until final completion and acceptance of all Work covered by this Contract. If the Owner, at any time after fifty percent (50%) of the Work has been completed, finds that satisfactory progress is being made, then the Owner may make any of the remaining progress payments in full; and provided further that, upon completion and acceptance of each separate building, or other division of the Contract on which the price is stated separately in the Contract, payment may be made in full including retained percentages thereon less authorized deductions. After Substantial Completion of the Work the Owner shall, upon application by the Contractor, approved by the Architect/Engineer, 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 the retainage stipulated in the Contract Documents, and if bonds have been furnished as provided in Article 3, such payment may be made under the terms and conditions governing final payment, and shall not constitute a waiver of claims. Final payment shall be made after completion of the Work by the Contractor in accordance with the Contract Documents.

7.2.2.1 The provisions of Government Code 2251.021 through 2251.023 apply to payments under this Contract.

7.2.2.2 Any request for reduction or release of retainage

shall be accompanied by written consent of the Contractor's Surety to the request.

7.2.3 In preparing Applications for Payment all materials delivered and labor performed shall be included in the progress upon which payment is based. However, payment for materials will not be made prior to approval of materials for which submission of a Technical Submittal is required. Furthermore, payment for stored materials will be on the basis of provided invoices.

7.2.4 The Owner may withhold or, on account of subsequently discovered evidence, nullify that part of any Application for Payment to such extent as may be necessary to protect the Owner from loss on account of:

.1 Defective Work not remedied.
.2 Damage to Work of another Contractor.
.3 Failure to maintain scheduled progress.
.4 Receipt of written notice by the Owner of unpaid bills, as stipulated in Sec. 53.232, Texas Property Code, if the Contractor has not provided a payment bond and if the Contract Sum does not exceed $25,000.00. Any funds so withheld shall be released to the Contractor if the Contractor furnishes a bond for release of lien as provided in Sec. 53.236, Texas Property Code. When the above grounds are removed, payment will be made for amounts withheld because of them.
.5 Persistent failure to carry out the Work in accordance with the Contract Documents.
.6 Reasonable evidence that the Work will not be completed within the Contract Time.
.7 Reasonable evidence that the Work cannot be completed for the remainder of the Contract Sum.
.8 Assessment of fines for violations of Prevailing Wage Rate laws.

7.2.5 All material and Work covered by progress payments made shall thereupon become the sole property of the Owner, but this provision shall not be construed as relieving the Contractor from the sole responsibility for the care and protection of materials and Work upon which payments have been made or the restoration of any damaged Work, or as a waiver of the right of the Owner to require the fulfillment of all of the terms of the Contract.

7.2.6 Payments to the Contractor shall not be construed to release the Contractor or the Contractor's Surety from any obligations under this Contract.

7.2.7 Upon the Owner's request, manifest proof of the status of Subcontractor accounts shall be furnished in a form acceptable to the Owner.

7.2.8 Applications for Payment must be signed by a corporate officer or a representative specifically named by the Contractor.

7.2.9 If the Owner so requires, then the Contractor in requesting payment for materials, shall provide copies of bills of lading, invoices, delivery receipts or other evidence of the location and value of such materials.

7.3 Claims for Unpaid Labor and Materials:

7.3.1 When the value of the Contract between the Owner and the Contractor is not in excess of $25,000.00, claimants are referred to Texas Property Code, Section 53.231, for requirements that are prerequisite to the filing of a valid lien on funds unpaid to the Contractor at the time of filing of the claim.

7.3.2 When the Contract between the Owner and the Contractor is in excess of $25,000.00, claims must be sent directly to the Contractor and the Contractor's Surety in accordance with Chapter 2253, Texas Government Code. The Owner will furnish, in accordance with such Article, a copy of the Payment Bond to claimants upon their request.

7.3.3 All claimants are cautioned that no lien exists on the funds unpaid to the Contractor on such Contract, and that reliance on notices sent to the Owner may result in loss of their rights against the Contractor and/or the Contractor's Surety. The Owner is not responsible in any manner to a claimant for collection of unpaid bills, and accepts no such responsibility because of any representation by any agent or employee.

ARTICLE 8

CONTRACT COMPLETION TIME

8.1 Notice to Proceed: The Contract Time will begin on the date designated in the Notice to Proceed issued by the Owner after receipt of the fully executed Owner-Contractor Agreement, the Performance Bond, Payment Bond, and required insurance documentation. The Contractor is required to complete the Work in the time that is stated in the Supplementary Conditions of the Contract for Construction or any extension thereof. The Owner may delay the Work, or any part thereof, for any reason, in which case the time for completion of the Work will be extended by an equivalent amount of time.

8.2 Construction Schedule:

8.2.1 The Contractor is responsible for developing its own schedule logic with appropriate durations and manpower; however, all information must be acceptable and compatible with the Owner’s needs, and all target,

completion and milestone dates generated must be acceptable to the Owner. Within 14 days after the Notice to Proceed, the Contractor shall prepare and submit for approval by the Owner a detailed network construction schedule using precedence format with activity numbers based on a reasonable, rational system for identification purposes. Durations shall be in working days and appropriate to the activity. The Owner reserves the right to reject any schedule or report that fails to reflect timely completion of the Project, or any intermediate milestone, or otherwise indicates unrealistic performance. Failure of the Contractor to delivery satisfactory schedules or reports to Owner will result in temporary suspension of progress payments.

8.2.2 The detailed construction schedule submitted by the Contractor shall reflect complete sequence of construction by activity including:

.1 Submittal and shop drawing activities for procurement packages and equipment,
.2 Product procurement and delivery dates including long lead items,
.3 Contractual milestone dates,
.4 Dates for beginning and completion of each element of construction,
.5 Disruptions and shutdowns due to other operations, facilities and functions,
.6 Anticipated periods of overtime or shift work,
.7 Dates for installation and testing of all equipment,
.8 Cleanup,
.9 Contract startup and closeout.

8.2.3 On a weekly basis, the current detailed construction schedule shall be provided by the Contractor, who shall give a brief report describing activities begun or finished during the preceding week and a projection of all activities to be started or finished in the week to follow.

8.2.4 Each month the Contractor shall provide a revised detailed construction schedule consisting of bar chart summaries and (if requested by the Owner) revised network diagrams and tabular lists of activities plus certified data which:

.1 shows all changes occurring since the previous submission of the updated schedule,
.2 indicates progress of each activity and shows completion dates,
.3 includes:
  .1 major changes in scope and logic changes
  .2 activities modified since previous updating
  .3 identification of any slippage
  .4 revised projections due to changes
  .5 out-of-sequence progress
  .6 other identifiable changes

In the event that a revised detailed construction schedule is not acceptable to the Owner, then said schedule shall be revised by the Contractor until it is found acceptable by the Owner.

8.3 Delays and Extension of Time:

8.3.1 The Contractor may be granted a time extension by the Owner because of changes ordered in the Contract or because of strikes, lockouts, fire, unusual delay in transportation, unavoidable casualties, inclement weather in excess of normal, or any cause beyond the Contractor's control, which affected critical path activities. The Owner may extend the Contract Time subject to the following provisions.

8.3.2 Claims for time extensions must be made in writing within thirty (30) calendar days after the occurrence of the delay. All time extension claims shall be supported by comparing the original Construction Schedule with an updated Schedule indicating delays to critical path activities**.** In the case of a continuing cause of delay, only one claim is necessary. Claims for time extensions shall be stated in numbers of whole or half work days. In case of claims for time extension because of inclement weather in excess of normal, such time extension shall be granted only because such inclement weather prevented the execution of critical path activities of Work which delayed the final completion of the Contract. Resolution of delay claims shall be made at the Date of Substantial Completion.

8.3.2.1 The Owner's representative shall ascertain the facts and the extent of the delay and extend the Contract Time when (in the representative's judgment) the findings justify such an extension of Contract Time. The findings of the Owner's representative are final and conclusive on both parties and subject only to appeal as provided in Subparagraph 5.2.1.

8.3.2.2 The Contractor shall notify the Owner of delays to critical path items as they occur; and these delays shall be identified during the weekly progress meetings.

8.3.2.3 Time extensions granted for causes described herein will be granted on the basis of one Regular Work Day extension for each Regular Work 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 Inclement Weather days).

8.3.2.4 Each Proposer shall include Anticipated Inclement Weather Days in his proposed Contract Time as noted in the following schedule:

Number of Anticipated Inclement Weather Days to be Included in Proposed Contract Time (These are regular

work days)

January	-3	July	-4
February	-4	August	-4
March	-4	September	-4
April	-2	October	-3
May	-5	November	-5
June	-6	December	-4

8.3.2.5 Inclement Weather Days shall pertain to such items as rain, flooding, snow, unusually high winds, which prevent progress on major portions of the Work on regular work days only. If such situations occur on more than the Number of Anticipated Inclement Weather Days included in the Proposed Contract Time and if those additional days prevent the Contractor from performing critical portions of the scheduled Work, then time extensions caused by inclement weather may be requested as enumerated hereinafter. If the inclement weather is rain related, then the rain at the site must have been in excess of 0.50 inch in 24 hours.

8.3.2.6 At the beginning of each month the Contractor shall submit a schedule showing 1) the scheduled number of Anticipated Inclement Weather Days for the particular month, 2) the Actual Inclement Weather Days requested, and 3) the Net Inclement Weather Days (plus, minus, or no change). At times deemed appropriate by the Architect, the Contract Time will be adjusted by Change Order if the total of Net Inclement Weather Days is substantially greater than 0. If at the end of the Project all Anticipated Inclement Weather Days have not been used, then the Contract Time will not be reduced. An example of the monthly schedule to be submitted is as follows:

Month	Anticipated Inclement Weather Days(Regular)	Actual Inclement Weather Days (Regular) Requested	Net Inclement Weather Days(Regular)
January	3	8	5
February	4	0	-4
March	4	2	-2
April	2	2	0
May	5	7	2
June	6	10	4
TOTAL	24	29	5

Using this example, there were five (5) Net Inclement Weather Days (regular) for the first six (6) months of the Project and the extension of Contract Time would be seven (7) calendar days (since a seven (7) calendar days extension is granted after five (5) Regular Work Days are lost).

8.3.3 The Contractor shall have no claim for compensation or damages due to delays in, or hindrances to, the Work and further agrees that the Contractor shall be fully compensated for all delays solely by a time extension.

8.3.4 No time extension shall release the Contractor or the Surety furnishing a performance or payment bond from all obligations thereunder; which obligations shall remain in full force until the discharge of the Contract.

8.3.5 No time extensions will be allowed for any of the following conditions:

8.3.5.1 At least seven (7) hours of available work time out of the work day.

8.3.5.2 Saturdays, Sundays or Holidays unless the Contract requires and stipulates overtime work.

8.3.5.3 Time required for drying of materials when it is possible for the Contractor to enclose the area and use drying devices.

8.3.6 The Contractor shall maintain a Project log indicating all time in excess of one (1) hour for which work was suspended during a work day in order to obtain any time extension.

8.3.7 The Contractor shall obtain approval from the Owner for work during the following times:

8.3.7.1 Saturdays, Sundays or Holidays.

8.3.7.2 Prior to 7:00 am and after 7:00 pm on scheduled work days.

8.4 Completion of Work: The Contractor will be held to account for the Work being completed in the Contract Time, or any extension thereof.

8.4.1 If, in the judgment of the Owner, the Work is behind schedule and the rate of placement of Work is inadequate to regain scheduled progress so as to insure timely completion of the entire Work or a separable portion thereof, then the Contractor, when so informed by the Owner, shall immediately take action to increase the rate of Work placement. This increase shall be accomplished by any one or a combination of the following or other suitable measures:

.1 An increase in Work forces.
.2 An increase in equipment or tools.
.3 An increase in hours of work or number of shifts.
.4 Expediting delivery of materials.

8.4.2 The Contractor shall, within ten (10) calendar days after being so informed, notify the Owner of the specific measures taken and/or planned to increase the

rate of progress together with an estimate as to when scheduled progress will be regained. Should the plan of action be deemed inadequate by the Owner, the Contractor shall take additional steps or make adjustments as necessary to the plan of action until it meets with the Owner's approval. The increased rate of work will continue until scheduled progress is regained. Scheduled progress will be established from the latest revised and accepted progress schedule for the Project. Timely completion will be understood to be the Contract completion date as revised by all time extensions granted at the time acceleration is undertaken. The Contractor shall not be entitled to additional compensation for the additional effort applied to the Work under the terms of this Subparagraph.

8.5 Failure to Complete Work on Time: The time set forth in the Supplementary Conditions of the Contract for Construction for the completion of all Work is an essential element of the Contract. Contractor's failure to complete the Work within such time will cause damage to the Owner. The value of such damages shall be stated in the Supplementary Conditions of the Contract for Construction.

8.5.1 The time specified for completion in the Supplementary Conditions of the Contract for Construction shall cover final cleanup of the premises and completion of punch list deficiencies.

8.5.2 For each consecutive calendar day after the expiration of the Contract Time that any Work (including the correction of deficiencies found during the Final Inspection) is not completed and accepted, the amount per day as stipulated in the Supplementary Conditions of the Contract for Construction will be deducted from the money due or to become due the Contractor, not as a penalty but as liquidated damages and added expense for Contract supervision and Owner's delay costs in obtaining the use of the Work.

ARTICLE 9

CONTRACT SUBSTANTIAL COMPLETION

9.1 Certification: Should the Owner wish to use or occupy the Project, or part thereof, prior to final completion, and the Project, or a designated portion thereof acceptable to the Owner, is substantially complete, the Contractor shall prepare for and submit to the Architect/Engineer a comprehensive list of items to be completed or corrected. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. When the Owner and Architect/Engineer on the basis of a Pre-Final Inspection determine that the Project or designated portion thereof is substantially complete, the Architect/Engineer will then prepare a Certificate of Substantial Completion which shall establish the Date of Substantial Completion; shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, operation of permanent equipment, damage to the Work, and insurance; and shall fix the time within which the Contractor shall complete all items on the list accompanying the Certificate.

9.1.1 Prior to the Pre-Final Inspection, and as a prerequisite to issuance of a Certificate of Substantial Completion, the Contractor shall furnish to the Owner all Record Documents, instructional manuals, maintenance manuals, parts catalogs, wiring diagrams, operational manuals, maintenance material stocks, spare parts and tools, specified written warranties, guarantees and like publications or parts for all installed equipment, systems and like items required by the Contract Documents; and shall conduct all instruction of the Owner's personnel required by the Contract Documents. If the Contractor does not furnish these requirements and the Owner must, out of necessity, obtain these materials, instructions, information and data, then the cost for this procurement will be deducted from the monies due the Contractor.

9.1.2 If the Owner must take occupancy of the Project due to compliance with State laws and the Project is not substantially complete, then the Contractor shall purchase extended warranties on equipment which must be in operation for the Owner to take occupancy.

9.2 Date of Substantial Completion: The Date of Substantial Completion of the Project, or designated portion thereof, is the date jointly certified by the Architect/Engineer, Owner and Contractor when construction is Substantially Complete as herein before defined.

9.3 Additional Inspection Costs: The Contractor shall be charged by the Owner for any costs of re-inspection resulting from substantial differences between the Contractor's list of items to be completed or corrected and the list of items resulting from the Pre-Final Inspection.

ARTICLE 10

CONTRACT FINAL ACCEPTANCE AND PAYMENT

10.1 Notification: When the Project is completed, the Contractor shall notify the Owner in writing that the Project will be ready for Final Inspection on a definite date. Upon verification by the Contractor that the Project

is ready for Final Inspection and acceptance, the Architect/Engineer and the Owner will within ten (10) calendar days make a Final Inspection and, when the Project is found acceptable under the Contract Documents and the Contract is fully performed, make final payment to the Contractor.

10.2 Final Payment Documentation: Neither the final payment nor the remaining retained percentage shall become due until the Contractor submits to the Architect/Engineer for transmittal to the Owner:

.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 Contractor's, Subcontractor's, Sub-subcontractor's, and Supplier's separate releases on the prescribed forms.
.4 Consent of Surety to Final Payment, AIA Document G707 (if applicable).
.5 Final list of Subcontractors and Sub-subcontractors, AIA Document G805.
.6 The Contractor and each and every Subcontractor, Sub-subcontractor and Supplier shall provide a"Certificate of No Asbestos, PCB and Lead". *The form used shall be the attached form on Page 28 of these General Conditions.* For the purpose of definition as used in this form, the term "potable water systems" includes, but is not limited to, those water systems for drinking fountains, all sinks and lavatories, showers, bath tubs, residential and commercial kitchen equipment, icemakers, and hose bibbs, as applicable to this specific Project.
.7 Material Safety Data Sheets: Effective September 1, 2000, the Texas Department of Health implemented a new rule in the AHERA Regulation which requires that Material Safety Data Sheets be provided to the Owner by the Contractor on the materials incorporated into the Work which but not limited to the list below (not all of which may have been used in this specific Project):
  .1 Floor Tiles
  .2 Sheet Floorings
  .3 Adhesives (Mastics)
  .4 Suspended Ceiling Tiles
  .5 Glued-on/Nailed-on Ceiling Tiles
  .6 Gypsum Board
  .7 Blown-in Insulation
  .8 Batt/Roll Insulation
  .9 Gaskets
  .10 Sprayed-on/Troweled-on Surfacing Materials
  .11 Pipe Insulation
  .12 Pipe Fitting Insulation
  .13 Boiler Insulation
  .14 Flue Insulation (Vent Pipe Insulation)
  .15 Heating/AC Ducting
  .16 Air Handler Cloth Joint (Flex Joint)
  .17 Air Handler Insulation

If Material Safety Data Sheets are not provided by the Contractor, then the Contractor shall be responsible for obtaining samples of the materials listed above and the required testing of the samples at no additional cost to the Owner. These Material Safety Data Sheets shall be included in the maintenance and instruction manuals.

10.3 Final Payment:

10.3.1 The making of final payment shall constitute a waiver of all claims by the Owner except those arising from:

.1 Faulty or defective Work appearing after Substantial Completion;
.2 Failure of the Work to comply with the requirements of the Contract Documents; or
.3 Terms of any special warranties required by the Contract Documents.

10.3.2 Acceptance of final payment shall constitute a waiver of all claims by the Contractor except those specifically enumerated at the time of final payment.

ARTICLE 11

CONTRACT CORRECTION PERIOD

11.1 One Year Contract Correction Period: Except as otherwise specified, the Contractor warrants and guarantees all Work against defects in materials, equipment or workmanship. For one (1) year from the date of Substantial Completion of the entire Project or designated portions thereof, the Contractor shall undertake correction, repair or replacement of any defective of non-conforming work.

11.2 Remedy of Defects Under Warranty: Upon receipt of written notice from the Owner of the discovery of any defects, the Contractor shall remedy the defects and replace any property damaged therefrom occurring within the contract correction period. If the Contractor, after notice, fails to proceed and remedy such defects within five (5) days or within any other period of time which has been agreed in writing, or to comply with the terms of the warranty and guarantee, then the Owner may have the defects corrected and the Contractor and the Contractor's Surety shall be liable for all expenses incurred. If the defect needs immediate correction, e.g., A/C system fails causing possible dismissal of school, then the Owner will contact the Contractor, Subcontractor, Sub-subcontractor, or manufacturer (whichever applies), advise them of the defect and make repairs. An itemized list of labor and materials with

certified payrolls and material invoices will be forwarded to the Contractor for payment.

ARTICLE 12

OPERATION AND STORAGE AREAS

12.1 Contractor's Use of Premises: The Contractor will operate and maintain operations areas and associated storage areas at the Project site in accordance with the following:

12.1.1 All Contractor operations, including storage of materials and employee parking upon the Project site, shall be confined to areas designated by the Owner.

12.1.2 The Contractor may erect temporary buildings at its expense, which shall remain its property. The Contractor shall remove such buildings and associated utilities service lines upon completion of the Project, unless the Contractor requests and the Owner provides written consent that it may abandon such buildings and utilities in place.

12.1.3 The Contractor will use only established roadways, or construct and use such temporary roadways as may be authorized by the Owner. Load limits of vehicles shall not exceed the limits prescribed by appropriate regulations or law. The Contractor will provide protection to existing and new road surfaces, curbs, sidewalks, trees, shrubbery, sprinkler systems, drainage structures and other like existing and new improvements to prevent damage. Any damage thereto shall be repaired by, and at the expense of, the Contractor.

12.1.4 The Owner may restrict the Contractor's entry to the Project site to specifically assigned entrances and routes.

12.2 Contractor's Maintenance of Premises: The Contractor shall at all times keep the Project site free from the accumulation of waste, waste materials, rubbish, or construction debris during performance of Work.

12.2.1 During the period of construction, and not less frequently than once a week, the Contractor shall remove from the Project site any and all waste materials, rubbish, construction debris and trash; and shall dispose of such waste materials, rubbish, construction debris and trash off the property of the Owner. The Contractor shall mow and trim the grass within the Project site at least every other week throughout the entire Contract Time.

Prior to the Contractor's requested date for a Pre-Final Inspection, the Contractor shall remove any and all remaining equipment from the Project site and shall leave the premises in a clean, neat and workmanlike condition satisfactory to the Owner.

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 2, 2025

Texas Gulf Coast Area

CLASSIFICATION	2025 HOURLY RATE
ASBESTOS WORKER	$27.20
BRICKLAYER; MASON	$24.90
CARPENTER; CASEWORKER	$23.13
CARPET LAYER; FLOOR INSTALLER	$26.20
CONCRETE FINISHER	$23.83
DATA COMM/TELE COMM	$24.33
DRYWALL INSTALLER; CEILING INSTALLER	$24.33
ELECTRICIAN	$29.86
ELEVATOR MECHANIC	$39.78
FIREPROOFING INSTALLER	$22.99
GLAZIER	$23.25
HEAVY EQUIPMENT OPERATOR	$22.17
INSULATOR	$21.95
IRONWORKER	$26.50
LABORER, HELPER	$19.81
LATHERER; PLASTERER	$22.75
LIGHT EQUIPMENT OPERATOR	$28.75
METAL BUILDING ASSEMBLER	$24.00
PAINTER; WALL COVERING INSTALLER	$20.17
PIPEFITTER	$29.82
PLUMBER	$27.98
ROOFER	$22.50
SHEET METAL WORKER	$29.96
SPRINKLER FITTER	$23.00
STEEL ERECTOR	$26.00
TERRAZZO WORKER	$22.75
TILE SETTER	$22.00
WATERPROOFER; CAULKER	$24.00

This document was developed by PBK Architects, Inc., in strict accordance with Chapter 2258 of the Texas Government Code.

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 build 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.
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.

ARTICLE 3 – CONTRACT DOCUMENTS AND BONDS

Copies Furnished: Drawings and the Project Manual: The Contractor will be furnished free of charge **three (3) sets** of the Drawings and Project Manual. Additional sets will be furnished at the cost of reproduction, postage and handling.

ARTICLE 4 – CONTRACT ADMINISTRATION

Subcontracts:

The Contractor shall contract only with subcontractors for the Mechanical, Plumbing, Electrical, Security, Fire Alarm and P.A. Systems per the following: None

ARTICLE 5 – CONTRACT RESPONSIBILITIES:

The existing site and buildings are considered in good condition. The selected contractor shall document through the use of video or camera media any existing defects (including, but not limited to, staging and site work areas) prior to the start of any construction. Copies of the videotapes or photographs must be filed with the Architect and Owner prior to the start of any construction. Any and all defects not specifically identified prior to construction shall be repaired/replaced to the satisfaction of the Owner at no additional cost to the Owner.

ARTICLE 8 – CONTRACT COMPLETION TIME:

8.1 Notice to Proceed: Add the following: The following Schedule is for approval and execution of the Standard Form of Agreement between Owner and Contractor. These dates are planned and subject to changes. GPISD will make every attempt to maintain the schedule; however, if revisions are required to activities controlled by the Owner which delay the issuance of the "Notice to Proceed: then the Date of Substantial Completion will be revised by maintaining the same durations for construction.

Activity	Responsibility	Dates
.1 Prepare and forward to Contractor	Owner	August 4, 2025
.2 Contractor execution	Contractor	August 8, 2025
.3 Board of Trustees Approval and Execution	Owner	August 11, 2025
.4 Contractor obtain bonds & Insurance	Contractor	August 18, 2025
.5 Issue "Notice to Proceed"	Owner	August 25, 2025
.6 Date of Substantial Completion	Contractor	June 10, 2026

Liquidated Damages: Add the following: Time is of the essence of this Contract. Contractor acknowledges and agrees that its failure to complete the Work within the Contract Time shall cause damage to the Owner, and further agrees that the amount of such damage cannot be accurately measured or is difficult to ascertain. Therefore, Contractor agrees that for each and every calendar day the Work or any portion thereof shall remain uncompleted after the expiration of the Contract Time Contractor shall pay to Owner

as Liquidated Damages in the sum of $2,000 per calendar day after substantial completion. Owner shall have the right to withhold and deduct the amount of any or all such damages from any moneys owned to the Contractor.

CC - SPECIAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

The following are special conditions of the Galena Park Independent School District Contract for Construction.

SCHOOL SCHEDULE

The Owner currently plans the following school operations on or near the site of the Work during the Contract Time:

1. Full school operations will be conducted at the school during the normal school year. During the summer vacation, limited school operations will be conducted.

2. When school is in session, if the Contractor is going to work during time periods listed below, then the Contractor will include in its Base Proposal the cost of a GPISD employee at the rate of $50.00 per hour to operate the security system and provide access to the facility.
    a. Prior to 7:00 AM, after 11:00 PM.
    b. Weekends - refer to attached schedule.
    c. Holidays - refer to attached schedule
3. The Contractor shall recognize the critical need for safety of all persons involved in the school program, and the need to conduct construction operations in such a way as to minimize disruption of school program operation. Contractor understands that it is the obligation of the Contractor to protect the Work, materials and equipment from vandalism and theft, and that it cannot rely on school security personnel to perform this function.
4. Critical areas and systems including, but not limited to, air conditioning system, electrical system and kitchen must remain functional at all times while the school is in operation. Any renovation work that would require a shut down of these items must be accomplished during vacations, holidays, or at other times when the school is not operating.

CRIMINAL HISTORY

If Contractor does not have access to the criminal history records of employees who will work at the Sites, Contractor shall ensure such employees cooperate and submit all information necessary for District's LEE Fast Pass procedure.

2025 | 26 SCHOOL CALENDAR

July 2025

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

August 2025

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

September 2025

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

October 2025

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

November 2025

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

December 2025

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

January 2026

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

February 2026

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

March 2026

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April 2026

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May 2026

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
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June 2026

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28	29	30				

Important Dates

August 12 — First Day of School
May 22 — Last Day of School

New Teacher Orientation

July 29 - August 1

Student Holiday/Staff Development

August 4 - 11, 29
October 14
January 5
March 6
September 19
November 3, 4
February 13
April 2

Early Dismissal All Campuses

December 19
May 22

Holidays

July 4
October 10 - 13
Dec. 22 - Jan. 2
February 16
April 3 - 6
June 19
September 1
November 24 - 28
January 19
March 9 - 13
May 25

LEGEND
- Student Holiday/Staff Development
- District Holidays
- School Holidays, except for EOC Testing
- New Teacher Orientation
- Early Dismissal - All Campuses

SCHOOL HOURS

Elementary School	7:35 am - 3:15 pm
Middle School	8:20 am - 4:00 pm
High School	7:05 am - 2:45 pm
Early College High School	8:00 am - 4:15 pm
Zotz Education Center	8:15 am - 3:55 pm

Six Weeks Grading Period

High Schools

First Semester		Report Card Dates
1. Aug. 12 - Sept. 18	(26 days)	Sept. 26
2. Sept. 22 - Oct. 31	(27 days)	Nov. 7
3. Nov. 5 - Dec. 19	(28 days)	Jan. 9
Second Semester		
4. Jan. 6 - Feb. 12	(27 days)	Feb. 20
5. Feb. 17 - Apr. 1	(26 days)	Apr. 10
6. Apr. 7 - May 22	(34 days)	June 4

Nine Weeks Grading Period

Elementary/Middle Schools

First Semester		Report Card Dates
1. Aug. 12 - Oct. 9	(39 days)	Oct. 17
2. Oct. 15 - Dec. 19	(42 days)	Jan. 9
Second Semester		
3. Jan. 6 - Mar. 5	(40 days)	Mar. 20
4. Mar. 16 - May 22	(47 days)	May 26 ES/May 29 MS

State Testing Days

December 2 - 12	End of Course Testing
April 7 - April 24	STAAR/End of Course
May 4 - May 15	Dual Credit Finals/AP Testing
June 17 - 20	STAAR/End of Course Retest

(Subject to change if needed)

Galena Park Independent School District

14705 Woodforest Blvd. * Houston, Texas 77015 * 832-386-1000 * www.galenaparkisd.com

01/27/2025

2024 / 25 SCHOOL CALENDAR

July 2024

S	M	T	W	T	F	S
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August 2024

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September 2024

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October 2024

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November 2024

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December 2024

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January 2025

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February 2025

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March 2025

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April 2025

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May 2025

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June 2025

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15	16	17	18	19	20	21
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29	30					

Important Dates

August 7	First Day of School
May 23	Last Day of School

New Teacher Orientation
July 23 - 26

Student Holiday/Staff Development

July 30 - August 6, 30	September 20
October 15	November 4, 5
January 7, 8, 31	February 13
March 14	April 4, 22

Early Dismissal All Campuses

December 20	May 23

Holidays

July 4	September 2
October 11 - 14	November 25 - 29
Dec. 23 - Jan. 6	January 20
February 14-17	March 17 - 21
April 18 - 21	May 26
June 19	

LEGEND
- Student Holiday/Staff Development
- District Holidays
- School Holidays, except for EOC Testing
- New Teacher Orientation
- Early Dismissal - All Campuses

SCHOOL HOURS

Elementary School	7:35 am - 3:15 pm
Middle School	8:20 am - 3:56 pm
High School	7:05 am - 2:40 pm
Early College High School	8:00 am - 4:15 pm
Zotz Education Center	8:15 am - 3:50 pm

Six Weeks Grading Period

High Schools		Report Card Dates
First Semester		
1. Aug. 7 - Sept. 13	(26 days)	Sept. 20
2. Sept. 16 - Oct. 25	(26 days)	Nov. 1
3. Oct. 28 - Dec. 20	(33 days)	Jan. 10
Second Semester		
4. Jan. 9 - Feb. 21	(27 days)	Feb. 28
5. Feb. 24 - Apr. 11	(28 days)	Apr. 17
6. Apr. 14 - May 23	(27 days)	June 3

Nine Weeks Grading Period

Elementary/Middle Schools		Report Card Dates
First Semester		
1. Aug. 7 - Oct. 10	(44 days)	Oct. 18
2. Oct. 16 - Dec. 20	(41 days)	Jan. 10
Second Semester		
3. Jan. 9 - Mar. 13	(41 days)	Mar. 28
4. Mar. 24 - May 23	(41 days)	May 27 ES/May 30 MS

State Testing Days

December 3 - 13	End of Course Testing
April 8 - May 2	STAAR/End of Course/AP Testing
June 17 - 20	STAAR/End of Course Retest

(Subject to change if needed)

Galena Park Independent School District

14705 Woodforest Blvd. * Houston, Texas 77015 * 832-386-1000 * www.galenaparkisd.com

02/12/2024

Project Manual

for

PKG 3A – GPHS New Fieldhouse

PBK Project No.: 240539
Galena Park Project No.: 002.3-2025

for the

GALENA PARK INDEPENDENT SCHOOL DISTRICT

10 June 2025

Issue for Proposal

VOLUME 2

11 Greenway Plaza, 22nd Floor \\ Houston, Texas 77046 \\ P 713-965-0608 \\ F 713-961-4571 \\ PBK.com

Project Manual

for

PKG 3A – GPHS New Fieldhouse

PBK Project No.: 240539
Galena Park Project No.: 002.3-2025

for the

GALENA PARK INDEPENDENT SCHOOL DISTRICT

10 June 2025

Issue for Proposal

VOLUME 2

Board of Trustees

Ms. Norma Hernandez	President
Mr. Roman Garza	Vice President
Ms. Linda Clark Sherrard	Secretary
Mr. Noe Esparza	Trustee
Ms. Amanda Erebia	Trustee
Ms. Adrian Stephens	Trustee
Mr. Jose Jimenez	Trustee
Dr. John Moore	Superintendent of Schools

Project Manual

for

PKG 3A – GPHS New Fieldhouse

PBK Project No.: 240539
Galena Park Project No.: 002.3-2025

for the

GALENA PARK INDEPENDENT SCHOOL DISTRICT

10 June 2025

Issue for Proposal

VOLUME 2

Team

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

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

Civil
DIG Engineers
11 Greenway Plaza Blvd, Ste. 1520
Houston, Texas 77046
Phone: (346) 308-9036

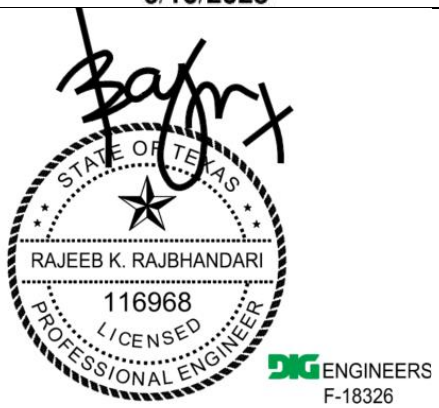
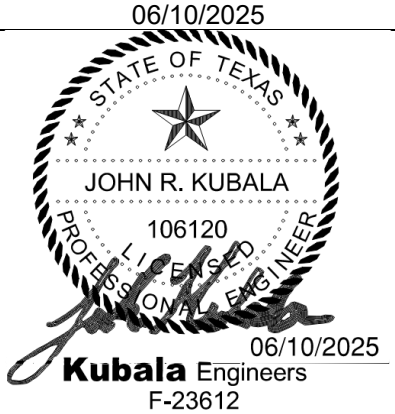
MEP
LEAF Engineers
11 Greenway Plaza Blvd, 15th Floor
Houston, Texas 77046
Phone: (713) 940-3300

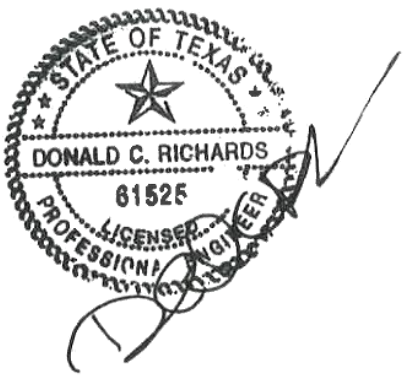
Facilities
BEAM Professionals
11 Greenway Plaza Blvd, 15th Floor
Houston, Texas 77046
Phone: (713) 965-0608

Landscape
Edgeland Group
11 Greenway Plaza Blvd, 15th Floor
Houston, Texas 77046
Phone: (713) 460-0988

Issue for Proposal

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

Architect of Record: Jan Lepicovsky R.A. # 25572	 6/10/2025	PBK 11 Greenway Plaza Blvd, 22nd Floor Houston, Texas 77046 Phone: (713) 965-0608
Engineer of Record, Civil: (Name) Rajeeb K. Rajbhandari P.E. # **116968**	 06/10/2025	DIG Engineers 11 Greenway Plaza Blvd, Ste. 1520 Houston, Texas 77046 Phone: (713) 965-.0608
Engineer of Record, Structural: John R. Kubala P.E. # 106120	 06/10/2025 **Kubala** Engineers F-23612	Kubala Engineers 11 Greenway Plaza Blvd, Ste. 1510 Houston, Texas 77046 Phone: (713) 940-3343

Engineer of Record, Mechanical: Mital J. Patel, P.E. P.E. #111622	 06.10.2025 LEAF ENGINEERS F-18672	LEAF Engineers 11 Greenway Plaza Blvd, 15th Floor Houston, Texas 77046 Phone: (713) 940-3300
Engineer of Record, Electrical, Plumbing & Technology: Donald C. Richards, P.E. P.E. #61525	 06.10.2025 LEAF ENGINEERS F-18672	LEAF Engineers 11 Greenway Plaza Blvd, 15th Floor Houston, Texas 77046 Phone: (713) 940-3300

DOCUMENT 00 00 10 TABLE OF CONTENTS

Section No.	*Title*
00 00 00	Project Manual Cover Sheet
00 00 01	Seals Page
00 00 10	Table of Contents
00 31 00	Affidavit of Non-Asbestos, Lead, and PCB
00 31 01	2025-2026 School Calendar
00 31 32	Geotechnical Data
00 31 32.1	Galena Park High School Boring Logs
00 73 50	Prevailing Wage Rate Determination Information

DIVISION 1 - GENERAL REQUIREMENTS

01 10 00	Summary
01 21 00	Allowances
01 22 00	Unit Prices
01 23 00	Alternates
01 25 13	Product Substitution Procedures
01 25 13.01	Request for Substitution Form
01 26 00	Contract Modification Procedures
01 29 00	Payment Procedures
01 29 73	Schedule of Values
01 29 73.1	Schedule of Values – Sample
01 31 00	Project Management and Coordination
01 32 00	Construction Progress Documentation
01 32 33	Photographic Documentation
01 33 00	Submittal Procedures
01 35 16	Alteration Project Procedures
01 40 00	Quality Requirements
01 42 00	References
01 45 23	Structural Testing and Inspection Services
01 45 23	Testing and Inspection Services
01 50 00	Temporary Facilities and Controls
01 55 26	Traffic Control
01 57 13.13	Filter Fabric Fence
01 57 13.14	Reinforced Filter Fabric Barrier
01 57 13.15	Stabilized Construction Exit
01 57 26	TPDES
01 60 00	Product Requirements
01 73 00	Execution
01 73 29	Cutting and Patching
01 77 00	Closeout Procedures
01 77 01	Closeout Forms (A-D)
01 77 02	Waiver and Release of Liens
01 78 39	Project Record Documents
01 79 00	Demonstration and Training

DIVISION 2 - EXISTING CONDITIONS

02 41 00	Demolition
02 41 13	Selective Demolition
02 41 13.23	Abandonment of Existing Utilities

DIVISION 3 - CONCRETE

03 05 80	Under Slab Vapor Retarder
03 10 00	Concrete Forming and Accessories
03 10 01	Spread Footings
03 11 00	Concrete Formwork

03 11 31 Void Forms
03 15 00 Concrete Accessories
03 15 13 Waterstops
03 20 00 Concrete Reinforcement
03 20 00 Concrete Reinforcing
03 21 00 Reinforcing Steel
03 30 00 Cast-in-Place Concrete (Civil)
03 30 00 Cast-in-Place Concrete (Structural)
03 35 00 Concrete Finishing
03 52 16 Lightweight Insulating Concrete Deck System

DIVISION 4 - MASONRY
04 05 00 Common Work Results Masonry
04 20 00 Unit Masonry
04 73 17 Calcium Silicate Manufactured Stone Masonry

DIVISION 5 - METALS
05 12 00 Structural Steel Framing
05 21 00 Steel Joist Framing
05 31 13 Steel Floor Decking
05 31 23 Steel Roof Decking
05 40 00 Cold Formed Steel Framing
05 50 00 Metal Fabrications
05 51 00 Metal Stairs
05 73 00 Decorative Metal Railings
05 75 00 Decorative Formed Metal

DIVISION 6 - WOOD, PLASTICS, AND COMPOSITES
06 10 00 Rough Carpentry
06 16 00 Sheathing
06 20 00 Finish Carpentry

DIVISION 7 - THERMAL AND MOISTURE PROTECTION
07 05 43 Cladding Support System
07 16 00 Below Grade Waterproofing
07 21 00 Thermal Insulation
07 27 26 Fluid Applied Air Barrier System
07 42 13 Metal Wall Panels
07 42 13.16 Metal Plate Wall Panels
07 54 19 Fully Adhered TPO Hybrid Membrane Roof
07 62 00 Roof Related Sheet Metal
07 65 00 Flexible Flashing
07 71 23 Manufactured Gutters and Downspouts
07 72 00 Roof Accessories
07 72 33 Roof Scuttle (Hatches)
07 92 00 Joint Sealants

DIVISION 8 - OPENINGS
08 11 13 Hollow Metal Doors and Frames
08 13 16 Aluminum Doors
08 14 16 Flush Wood Doors
08 31 00 Access Doors and Panels
08 33 13 Coiling Counter Doors
08 33 26 Overhead Coiling Grilles
08 43 13 Aluminum Framed Storefronts
08 71 00 Door Hardware
08 80 00 Glazing
08 83 00 Mirrors

DIVISION 9 - FINISHES

09 21 16 Gypsum Board Assemblies
09 30 00 Tiling
09 51 00 Acoustical Ceilings
09 54 26 Suspended Wood Ceilings
09 65 00 Resilient Flooring
09 65 13 Resilient Base and Accessories
09 65 66 Resilient Athletic Flooring
09 66 23.16 Epoxy Resin Terrazzo Flooring
09 67 00 Fluid Applied Flooring
09 68 00 Carpeting
09 84 00 Acoustic Room Components
09 90 00 Painting and Coating

DIVISION 10 - SPECIALTIES
10 11 00 Visual Display Units
10 12 00 Display Cases
10 14 00 Signage
10 21 13.19 Plastic Toilet Compartments
10 21 23 Cubical Curtains and Track
10 22 39 Folding Panel Partitions
10 26 00 Wall and Door Protection
10 28 00 Toilet, Bath, and Laundry Accessories
10 43 00 Emergency Aid Specialties
10 44 00 Fire Protection Specialties
10 51 13 Metal Lockers
10 56 13 Metal Storage Shelving
10 71 13.43 Fixed Sun Screens

DIVISION 11 - EQUIPMENT
11 21 73 Commercial Laundry and Dry Cleaning Equipment
11 30 13 Residential Appliances
11 46 83 Ice Machines
11 66 13 Exercise Equipment

DIVISION 12 - FURNISHINGS
12 11 13 Photo Murals
12 21 13 Horizontal Louver Blinds
12 22 00 Curtains and Drapes
12 24 00 Window Shades
12 32 00 Manufactured Casework
12 36 00 Countertops

DIVISION 13 – SPECIAL CONSTRUCTION
13 17 23 Therapeutic Pools
13 42 75 Integrated Interior Assemblies

DIVISION 14 – COVEYING EQUIPMENT
14 20 00 Elevators

DIVISION 21 – FIRE PROTECTION
21 05 00 Common Work Results for Fire Protection
21 05 29 Hangers and Supports for Fire Suppression System
21 05 48.13 Vibration Controls for Fire Suppression System
21 11 13 Fire Suppression Systems
21 30 00 Fire Pumps and Equipment

DIVISION 22 - PLUMBING
22 05 00 Common Work Results for Plumbing

22 05 16 Expansion Fittings and Loops for Plumbing Piping
22 05 29 Plumbing Hangers and Supports
22 05 48.13 Vibration Controls for Plumbing Piping and Equipment
22 08 00 Commissioning of Plumbing Systems
22 11 16 Domestic Water Piping
22 11 23 Domestic Water Pressure Booster System
22 13 16 Sanitary Waste and Vent Piping
23 20 23 Gas Piping
22 30 00 Plumbing Equipment
22 40 00 Plumbing Fixtures

DIVISION 23 - MECHANICAL

23 05 00 Common Work Results for HVAC
26 05 14 Variable Frequency Drives
26 05 19 Meters and Gages for HVAC Piping
26 05 23 General Duty Valves for HVAC Piping
23 05 29 Hanger and Supports for HVAC Piping and Equipment
23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment
23 05 53 Identification for HVAC Piping and Equipment
23 05 93 Testing, Adjusting and Balancing for HVAC
23 07 13 Duct Insulation
23 07 16 HVAC Equipment Insulation
26 07 19 HVAC Piping Insulation
23 08 00 Commissioning of HVAC Systems
23 09 23 Direct Digital Controls
23 09 93 Sequences of Operation for HVAC Controls
23 21 13 Hydronic Piping
23 21 23 Hydronic Pumps
23 23 00 Refrigerant Piping
23 25 13 Water Treatment for Closed Loop Hydronic Systems
23 25 19 Flushing and Cleaning of Hydronic Piping Systems
23 31 13 Metal Ducts
23 33 00 Air Duct Accessories
23 34 00 HVAC Fans
23 36 00 Air Terminal Units
23 37 13 Diffusers, Registers and Grilles
23 51 00 Breechings, Chimneys and Stacks
23 52 16 Condensing Boiler
23 64 23 Scroll Water Chillers Air Cooled
23 74 13 Packaged Outdoor Central Station Air-Handling Units
23 81 26.16 Ductless Mini-Split-System Air-Conditioners
23 82 39.19 Electric Unit Heaters

DIVISION 26 - ELECTRICAL

26 05 00 Common Work Results for Electrical
26 05 19 Low Voltage Electrical Power Conductors and Cables
26 05 26 Grounding and Bonding for Electrical Systems
26 05 29 Hangers and Supports for Electrical Systems
26 05 33 Raceway and Boxes for Electrical Systems
26 05 53 Identification for Electrical Systems
26 09 14 Electrical Controls
26 09 23 Lighting Control Devices
26 20 00 Electrical Distribution Equipment
26 27 26 Wiring Devices
26 43 00 Surge Protection Devices (SPDs) for Low Voltage Electrical Power Circuits
26 50 00 Lighting

DIVISION 27 - COMMUNICATIONS

27 00 00 Basic Materials and Methods
27 10 00 Structured Cabling System
27 41 13 Audio Visual Systems
27 51 19 Sound Masking System
27 51 23 Integrated Electronic Communications and Clock Network
27 51 23.80 Local Sound Reinforcement Systems

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 05 00 General Electronic Safety Systems Requirements
28 23 00 IP Security Camera System
28 23 16 Aiphone Access Control System
28 31 00 Fire Detection and Notification System
28 72 40 Intrusion Detection and Access Control System

DIVISION 31 - EARTHWORK

31 11 00 Clearing and Grubbing
31 13 13.13 Waste Material Disposal
31 20 00 Earthwork
31 22 16.13 Roadway Excavation
31 23 00 Construction of Underground Utilities
31 23 23.13 Bank Sand Backfill
31 23 23.16 Cement Stabilized Sand Bedding and Backfill
31 31 16 Termite Control
31 32 13.17 Cement Stabilized Subgrade
31 32 13.19 Lime Stabilized Subgrade
31 32 13.20 Hydrated Lime and Lime Slurry
31 32 13.21 Lime Fly Ash Stabilized Subgrade
31 41 00 Trench Safety

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 13 13 Concrete Paving
32 16 13 Concrete Curb, Gutter, Sidewalks, and Driveways
32 17 23.13 Painted Pavement Markings
32 31 13 Chain Link Fence and Gates
32 31 19 Decorative Metal Fences and Gates
32 91 19.13 Topsoil
32 92 13 Hydro-Mulch Seeding
32 92 23 Fertilizer
32 92 23.13 Solid Sod

DIVISION 33 - UTILITIES

33 01 30.13 Sanitary Sewer TCEQ Manhole Requirements
33 11 00 Water Distribution System PVC
33 33 13 Sanitary Sewer Lines
33 41 00 Storm Sewer and Appurtenances
33 41 11 Closed Circuit Television Inspection
33 44 19 Storm Water Management

END OF DOCUMENT 00 00 10

DOCUMENT 00 31 00 - AFFIDAVIT OF NON-ASBESTOS, LEAD, AND PCB USE IN PROJECT

Upon completion of this form, return to the Architect upon close-out of the project.

PROJECT:
PKG 3 – GPHS New Fieldhouse
1000 Keene St.
Galena Park, Texas 77547

ARCHITECT:
PBK
11 Greenway Plaza, 22nd Floor
Houston, Texas 77046

ARCHITECT'S PROJECT NO. 240539

CONTRACTOR: _____

DATE:_____

(Name, address) _____

_____

AFFIDAVIT

The undersigned affirms and certifies that "to the best of their knowledge and belief asbestos, lead, and PCB containing materials have not been used or incorporated into the Work and lead or lead bearing materials have not been incorporated into potable water systems", including, but not limited to those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibbs, as applicable to the project, and that lead sheet flashing used in through roof plumbing penetration applications is the only lead on the Project.

_____
Company

_____
Printed Name

_____
Signature

STATE OF TEXAS)
)
COUNTY OF _____)

Sworn to and subscribed before me at _____, Texas, this the _____ day of _____, 20__.

_____
Notary Public in and for _____ County, Texas

END OF DOCUMENT 00 31 00

NOTE: THIS DOCUMENT MUST BE EXECUTED AND SUBMITTED AT PROJECT CLOSE-OUT

2025 | 26 SCHOOL CALENDAR

July 2025

S	M	T	W	T	F	S
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August 2025

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September 2025

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October 2025

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November 2025

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December 2025

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January 2026

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February 2026

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March 2026

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April 2026

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May 2026

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3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June 2026

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Important Dates

August 12 — First Day of School
May 22 — Last Day of School

New Teacher Orientation

July 29 - August 1

Student Holiday/Staff Development

August 4 - 11, 29
October 14
January 5
March 6
September 19
November 3, 4
February 13
April 2

Early Dismissal All Campuses

December 19
May 22

Holidays

July 4
October 10 - 13
Dec. 22 - Jan. 2
February 16
April 3 - 6
June 19
September 1
November 24 - 28
January 19
March 9 - 13
May 25

LEGEND
- Student Holiday/Staff Development
- District Holidays
- School Holidays, except for EOC Testing
- New Teacher Orientation
- Early Dismissal - All Campuses

SCHOOL HOURS

Elementary School	7:35 am - 3:15 pm
Middle School	8:20 am - 4:00 pm
High School	7:05 am - 2:45 pm
Early College High School	8:00 am - 4:15 pm
Zotz Education Center	8:15 am - 3:55 pm

Six Weeks Grading Period

High Schools

First Semester		Report Card Dates
1. Aug. 12 - Sept. 18	(26 days)	Sept. 26
2. Sept. 22 - Oct. 31	(27 days)	Nov. 7
3. Nov. 5 - Dec. 19	(28 days)	Jan. 9
Second Semester		
4. Jan. 6 - Feb. 12	(27 days)	Feb. 20
5. Feb. 17 - Apr. 1	(26 days)	Apr. 10
6. Apr. 7 - May 22	(34 days)	June 4

Nine Weeks Grading Period

Elementary/Middle Schools

First Semester		Report Card Dates
1. Aug. 12 - Oct. 9	(39 days)	Oct. 17
2. Oct. 15 - Dec. 19	(42 days)	Jan. 9
Second Semester		
3. Jan. 6 - Mar. 5	(40 days)	Mar. 20
4. Mar. 16 - May 22	(47 days)	May 26 ES/May 29 MS

State Testing Days

December 2 - 12	End of Course Testing
April 7 - April 24	STAAR/End of Course
May 4 - May 15	Dual Credit Finals/AP Testing
June 17 - 20	STAAR/End of Course Retest

(Subject to change if needed)

Galena Park Independent School District

14705 Woodforest Blvd. * Houston, Texas 77015 * 832-386-1000 * www.galenaparkisd.com

01/27/2025

DOCUMENT 00 31 32 - GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 LOG OF BORINGS/CONTRACTOR RESPONSIBILITY

A. A copy of the locations and log of borings is bound herein. Subsurface soil data derived from test borings are given only for the convenience of the Contractor, and neither the Owner nor the Architect assumes responsibility for the accuracy of or for the Contractor's interpretation of the data. Contractor is responsible for any conclusions drawn from the boring data and is responsible for the work without extra compensation irrespective of whether or not the subsurface conditions encountered agree with the boring data.

1.2 REPORT

A. The full geotechnical report prepared by the Owner's independent geotechnical and testing laboratory is available in the Architect's office for inspection by the Contractor.

B. This geotechnical report is not a part of the Contract Documents.

END OF DOCUMENT 00 31 32

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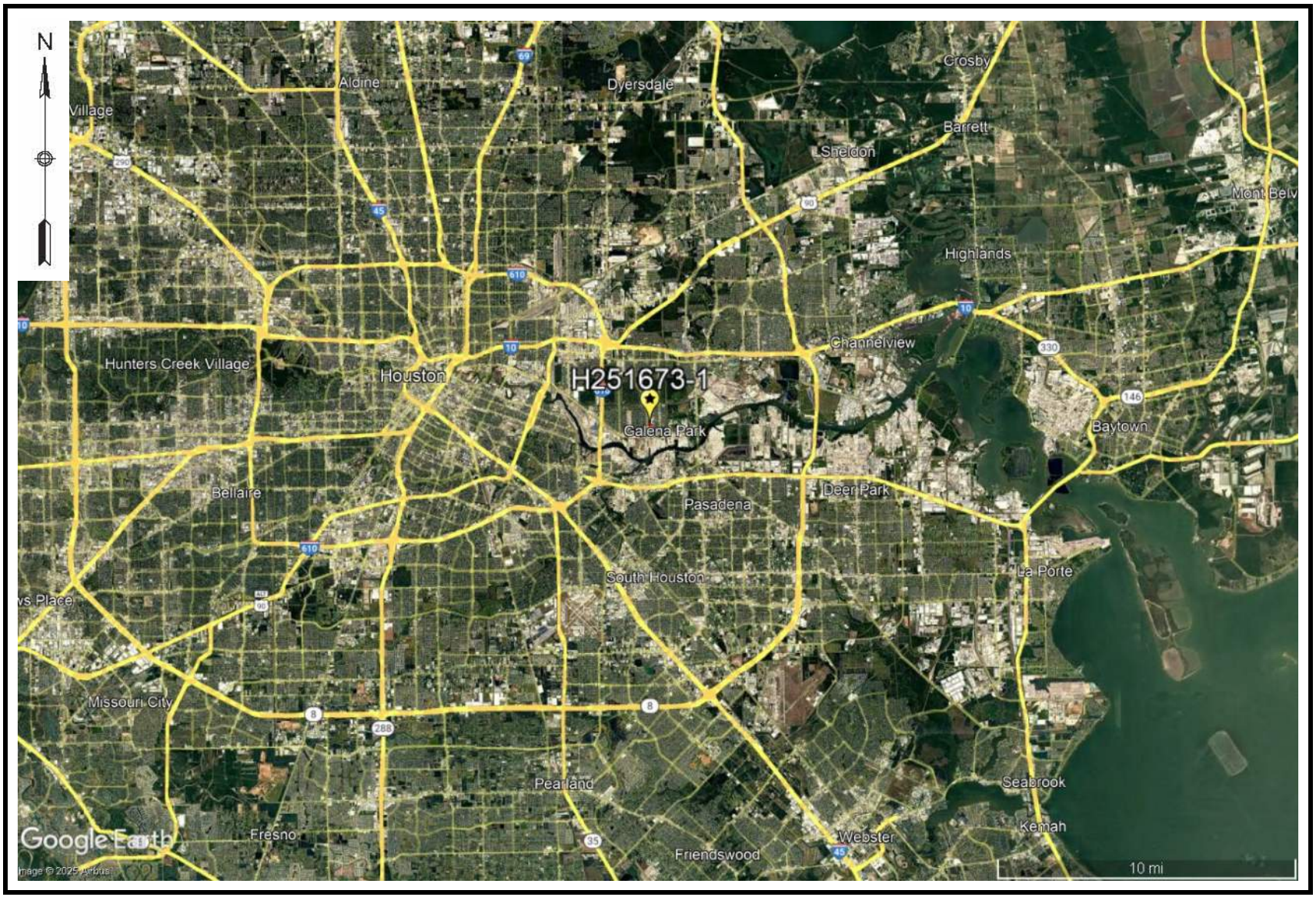
Appendix A - Project Location Diagrams

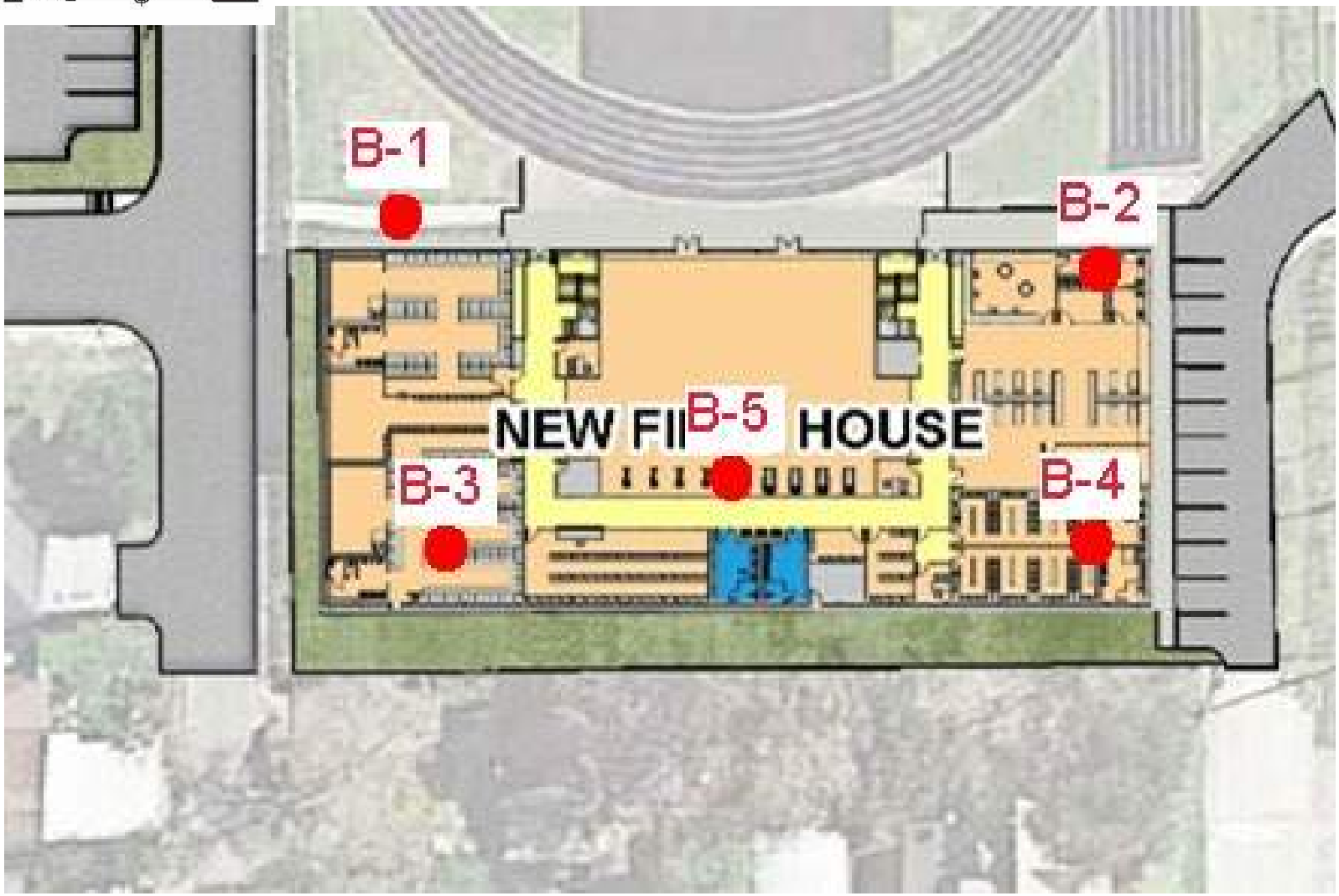
PROJECT LOCATION DIAGRAM - GENERAL



PROJECT LOCATION DIAGRAM - LOCAL

Appendix B - Boring Location Diagram

BORING LOCATION DIAGRAM



Appendix C - Boring Logs and Laboratory Results

UES Professional Solutions 44, LLC
15811 Tuckerton Road, Houston, TX 77095
Telephone: 713-360-0460; Fax: 713-360-0481

BORING NUMBER B-01

CLIENT Galena Park ISD
PROJECT NAME Galena Park High School - Phase 3A
PROJECT NUMBER H251673-1
PROJECT LOCATION Galena Park, TX 77547
DATE STARTED 4/19/25 **COMPLETED** 4/19/25
GROUND ELEVATION _____ **NORTHING** _____
CONTRACTOR UES
GROUND WATER LEVELS: **EASTING** _____
METHOD Auger 0 - 25 feet
▽ **INITIALLY ENCOUNTERED** 12.6 ft
LOGGED BY JA **CHECKED BY** V.G.
▼ **AFTER 15 MIN.** 11.1 ft
NOTES _____
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		SANDY LEAN CLAY (CL) FILL - Stiff, dark brown, with root fibers and sand seams.	ST			2.00					24	39	21	18	55
		FAT CLAY (CH) - Stiff, dark gray, gray.	ST			2.00					23				
5		With sand seams from 4 to 6 feet.	ST			2.00					26				
		With gravel from 6 to 8 feet.	ST			2.00					22	60	20	40	
10		Light gray, brown, light brown from 8 to 13 feet.	ST			2.50		1.7		100	24				
15		CLAYEY SAND (SC) - Stiff, light gray, light brown.	ST			2.00					20				
20			ST			2.00					20				
25		SANDY FAT CLAY (CH) - Very stiff, reddish brown, light gray, with sand seams.	ST			4.00					22				
		Bottom of hole at 25.0 feet.													

UES Professional Solutions 44, LLC
15811 Tuckerton Road, Houston, TX 77095
Telephone: 713-360-0460; Fax: 713-360-0481

BORING NUMBER B-02

CLIENT Galena Park ISD
PROJECT NAME Galena Park High School - Phase 3A
PROJECT NUMBER H251673-1
PROJECT LOCATION Galena Park, TX 77547
DATE STARTED 4/11/25 **COMPLETED** 4/11/25
GROUND ELEVATION _____ **NORTHING** _____
CONTRACTOR UES
GROUND WATER LEVELS: **EASTING** _____
METHOD _____
▽ **INITIALLY ENCOUNTERED** 11.0 ft
LOGGED BY JA **CHECKED BY** V.G.
▼ **AFTER 15 MIN.** 10.5 ft
NOTES _____
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		PAVEMENT - 2.5 inch thick concrete.	RC												
		SOIL BASE MATERIAL - 6 inches thick, with crushed concrete.	AU								19				
			AU												
		SANDY LEAN CLAY (CL) FILL - Dark gray, gray, with gravel.	ST			1.00		1.2		105	21				
5		LEAN CLAY (CL) / SANDY LEAN CLAY (CL) - Soft to stiff, Gray, brown, with sand seams. With gravel 2 to 8 feet.	ST			1.50					19	44	16	27	85
			ST			1.00					19				
		Reddish brown, light gray from 8 to 13 feet.	ST			3.00					15				
10															
		SILTY SAND (SM) - Medium dense, light brown, gray, with clay pockets.	SS		7-10-8 (18)						20				
15															
20			SS		5-7-12 (19)						22	NP	NP	NP	13
25			SS		8-9-12 (21)						23				
		FAT CLAY (CH) - Stiff, light gray, reddish brown, with sand seams.	SS		3-8-10 (18)						24				
30															
		SANDY SILTY CLAY (CL-ML) - Firm to very stiff, light gray, reddish brown.	ST			1.50					18				
35															
			SS		18-16-20 (36)						19				
40		Bottom of hole at 40.0 feet.													

TEST ONLY 2 H251673.GPJ NEW GINT TEMP.GDT 4/28/25

UES Professional Solutions 44, LLC
15811 Tuckerton Road, Houston, TX 77095
Telephone: 713-360-0460; Fax: 713-360-0481

BORING NUMBER B-03

CLIENT Galena Park ISD
PROJECT NAME Galena Park High School - Phase 3A
PROJECT NUMBER H251673-1
PROJECT LOCATION Galena Park, TX 77547
DATE STARTED 4/14/25 **COMPLETED** 4/14/25
GROUND ELEVATION _____ **NORTHING** _____
CONTRACTOR UES
GROUND WATER LEVELS: **EASTING** _____
METHOD _____
▽ **INITIALLY ENCOUNTERED** 13.0 ft
LOGGED BY JA **CHECKED BY** V.G.
▼ **AFTER 15 MIN.** 12.0 ft
NOTES _____
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		SANDY LEAN CLAY (CL) FILL - Hard, dark brown, gray, with root fibers and gravel.	ST			4.50+					9				
		FAT CLAY (CH) - Stiff, gray, reddish brown. With sand seams from 2 to 4 feet.	ST			2.00					23	64	20	44	
5		Brownish yellow, light gray from 4 to 6 feet.	ST			2.50					20				
		SANDY LEAN CLAY (CL) - Stiff, light brown, light gray, with sand seams.	ST			2.50					17				
10		CLAYEY SAND (SC) - Firm, light brown.	ST			1.50					17	26	15	11	49
15		LEAN CLAY WITH SAND (CL) - Very stiff, brownish yellow, light gray, with sand seams.	ST			3.50					19				
20		FAT CLAY (CH) - Stiff to very stiff, reddish brown, light gray, with sand seams.	SS		4-6-10 (16)						24				
25			ST			3.50					23				
30		Light gray from 28 to 33 feet.	ST			3.00		1.5		110	20				
35		SANDY SILTY CLAY (CL-ML) - Stiff, light gray.	SS		7-6-6 (12)						18				
40			SS		7-10-8 (18)						27				
		Bottom of hole at 40.0 feet.													

UES Professional Solutions 44, LLC
15811 Tuckerton Road, Houston, TX 77095
Telephone: 713-360-0460; Fax: 713-360-0481

BORING NUMBER B-04

CLIENT Galena Park ISD
PROJECT NAME Galena Park High School - Phase 3A
PROJECT NUMBER H251673-1
PROJECT LOCATION Galena Park, TX 77547
DATE STARTED 4/3/25 **COMPLETED** 4/3/25
GROUND ELEVATION _____ **NORTHING** _____
CONTRACTOR UES
GROUND WATER LEVELS: **EASTING** _____
METHOD _____
▽ **INITIALLY ENCOUNTERED** 12.0 ft
LOGGED BY JA **CHECKED BY** V.G.
▼ **AFTER 15 MIN.** 9.0 ft
NOTES _____
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		PAVEMENT - 7 inch thick Ashphalt.	RC												
		SOIL BASE MATERIAL - 7 inches thick.	AU												
		SANDY LEAN CLAY (CL) FILL - Dark brown, with sand seams.	AU								15				
		FAT CLAY (CH) - Firm, gray, reddish brown, with sand seams.	SS		3-5-3 (8)						21				
5		LEAN CLAY (CL) - Soft to stiff, brownish yellow, with sand seams.	ST			1.00					19	49	16	33	
			ST			1.00					17				
10			ST			3.00					17	39	18	21	
		SILTY SAND (SM) - Loose to midum dense, brown, light brown.	SS		4-4-5 (9)						17				
15															
			SS		5-7-7 (14)						20				
20															
			SS		4-6-5 (11)						20				
25		Bottom of hole at 25.0 feet.													

TEST ONLY 2 H251673.GPJ NEW GINT TEMP.GDT 4/28/25

UES Professional Solutions 44, LLC
15811 Tuckerton Road, Houston, TX 77095
Telephone: 713-360-0460; Fax: 713-360-0481

BORING NUMBER B-05

CLIENT Galena Park ISD
PROJECT NAME Galena Park High School - Phase 3A
PROJECT NUMBER H251673-1
PROJECT LOCATION Galena Park, TX 77547
DATE STARTED 4/11/25 **COMPLETED** 4/11/25
GROUND ELEVATION _____ **NORTHING** _____
CONTRACTOR UES
GROUND WATER LEVELS: **EASTING** _____
METHOD _____
▽ **INITIALLY ENCOUNTERED** 15.0 ft
LOGGED BY JA **CHECKED BY** V.G.
▼ **AFTER 15 MIN.** 13.0 ft
NOTES _____
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		PAVEMENT - 4.5 inch thick Ashphalt.	RC												
		SILTY SAND (SM) FILL - Dark brown, with root fibers.	AU								12	19	16	3	38
			ST			1.50					21				
		LEAN CLAY (CL) - Firm, gray, reddish brown, with sand seams.	ST			1.50					22				
		FAT CLAY (CH) - Firm to stiff, gray, dark gray.	ST			1.50					20	53	17	36	
		Light gray, reddish brown from 8 to 18 feet.	ST			2.00					24				
10															
			ST			2.00		2.8		106	20				
20		Reddish brown, light gray, with sand seams from 18 to 28 feet.	ST			3.00					23				
			ST			3.00					28				
30		LEAN CLAY WITH SAND (CL) - Stiff, light gray, reddish brown, with sand seams and layers.	ST			2.00					17				
		With calcareous nodules from 33 to 38 feet.	ST			2.50					19				
40		CLAYEY SAND (SC) - Loose, light brown, reddish brown.	SS		3-4-6 (10)						26				
		SILTY SAND (SM) - Medium dense, reddish brown.	SS		7-7-11 (18)						24				
50		SANDY SILTY CLAY (CL-ML) - Hard, reddish brown, light brown.	SS		20-42-27 (69)						27	23	17	6	51
		SANDY FAT CLAY (CH) - Very stiff, reddish brown.	SS		17-20-23 (43)						30				
		Reddish brown, light gray from 58 to 60 feet.									28				
60			SS		17-19-20 (39)						28				
		Bottom of hole at 60.0 feet.													

TEST ONLY 2 H251673.GPJ NEW GINT TEMP.GDT 4/28/25

ABSORPTION SWELL TEST (ASTM D4546) RESULTS						
Boring No.	B-01	B-03	B-04			
Average Sample Depth (ft)	7	3	9			
Sample Height (in)	1	1	1			
Sample Diameter (in)	2.5	2.5	2.5			
Initial Sample Volume (cu in)	4.91	4.91	4.91			
Initial Sample Weight (gr)	155.2	153.4	166.2			
Initial Moisture (%)	22	27	17			
Final Moisture (%)	22	29	17			
Initial Wet Unit Weight (pcf)	120	119	129			
Initial Dry Unit Weight (pcf)	99	94	110			
Applied Over Burden (psi)	6.1	2.6	7.8			
Initial Dial Reading (in)	0.0000	0.0000	0.0000			
Final Dial Reading (in)	0.0000	0.0040	0.0030			
Swell (%)	0.00	0.40	0.30			

Appendix H - Unified Soil Classification System

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

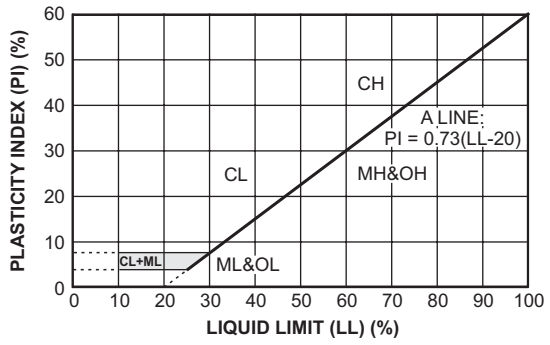
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

PLASTICITY CHART



TERMS DESCRIBING SOIL CONSISTENCY

Fine Grained Soils		Coarse Grained Soils		
Description	Penetrometer Reading (tsf)	Penetration Resistance (blows/ft)	Description	Relative Density
Soft	0.0 to 1.0	0 to 4	Very Loose	0 to 20%
Firm	1.0 to 1.5	4 to 10	Loose	20 to 40%
Stiff	1.5 to 3.0	10 to 30	Medium Dense	40 to 70%
Very Stiff	3.0 to 4.5	30 to 50	Dense	70 to 90%
Hard	4.5+	Over 50	Very Dense	90 to 100%

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 2, 2025

Texas Gulf Coast Area

CLASSIFICATION	2025 HOURLY RATE
ASBESTOS WORKER	$27.20
BRICKLAYER; MASON	$24.90
CARPENTER; CASEWORKER	$23.13
CARPET LAYER; FLOOR INSTALLER	$26.20
CONCRETE FINISHER	$23.83
DATA COMM/TELE COMM	$24.33
DRYWALL INSTALLER; CEILING INSTALLER	$24.33
ELECTRICIAN	$29.86
ELEVATOR MECHANIC	$39.78
FIREPROOFING INSTALLER	$22.99
GLAZIER	$23.25
HEAVY EQUIPMENT OPERATOR	$22.17
INSULATOR	$21.95
IRONWORKER	$26.50
LABORER, HELPER	$19.81
LATHERER; PLASTERER	$22.75
LIGHT EQUIPMENT OPERATOR	$28.75
METAL BUILDING ASSEMBLER	$24.00
PAINTER; WALL COVERING INSTALLER	$20.17
PIPEFITTER	$29.82
PLUMBER	$27.98
ROOFER	$22.50
SHEET METAL WORKER	$29.96
SPRINKLER FITTER	$23.00
STEEL ERECTOR	$26.00
TERRAZZO WORKER	$22.75
TILE SETTER	$22.00
WATERPROOFER; CAULKER	$24.00

This document was developed by PBK Architects, Inc., in strict accordance with Chapter 2258 of the Texas Government Code.

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 build 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.
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.

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Phased construction.
   4. Work by Owner.
   5. Work under separate contracts.
   6. Purchase contracts.
   7. Owner furnished products.
   8. Owner furnished, Contractor installed products.
   9. Access to site.
   10. Coordination with occupants.
   11. Work restrictions.
   12. Specification and drawing conventions.
   13. Miscellaneous provisions.

1.3 PROJECT INFORMATION

A. Project Identification: PKG 3A – GPHS New Fieldhouse
   1. Project Location: 1000 Keene St., Galena Park, Texas 77547

B. Owner: Galena Park Independent School District
   1. Owner's Representative: Ed Martir

C. Architect: PBK Architects

D. Consultants: Additional design professionals have been retained who have prepared designated portions of the Contract Documents.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following: Phase 3A will include the construction of a new Fieldhouse. It will take place of the existing fieldhouse at the West end of Dement Field to make way for a new Football & Field Sports Fieldhouse. The 2-story facility will include a weight room, trainer's suite, football, baseball and soccer lockers and storage rooms on the first floor. Coaches' offices and lockers, conditioning rooms and team rooms are located on the second floor. The total gross area of the fieldhouse is approximately 33,000 square feet.

B. Type of Contract: Project will be constructed under a Competitive Sealed Proposal (CSP) contract.

1.5 WORK BY OWNER AND UNDER SEPARATE CONTRACTS

A. Cooperate fully with Owner so Work may be carried out smoothly, without interfering with or delaying the work or work by Owner. Coordinate the Work with Work performed by Owner.

B. The Owner reserves the right to let separate contract for Work outside of the scope of this Contract. Cooperate fully with separate contractors so Work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with Work performed under separate contracts.

C. Purchase Contracts: The Owner reserves the right to negotiate purchase contracts with suppliers of material and equipment that may be incorporated into the Work. The Owner will assign these purchase contracts to Contractor. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum, unless otherwise indicated.
   1. Contractor's responsibilities are same as if Contractor had negotiated purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.

D. Owner Furnished, Contractor Installed Products (OFCI): The Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner furnished products and making building services connections when applicable.
   1. Owner Furnished Products: Coordinate with Owner.

1.6 ACCESS TO SITE

A. Use of Site: Limit use of Project site to Work in areas and areas within the Contract limits indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
   1. Limits: The drawings indicate the limits of the construction operations.
   2. Driveways, Walkways, and Entrances: Keep driveways. parking areas, student drop off and pick up points, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, the students, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
      a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
      b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform Work to prevent interference with Owner's day to day operations. Maintain existing exits unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
   2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
   1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.

2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, ensure mechanical and electrical systems are fully operational, and required tests and inspections and start up procedures are successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. Upon occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

A. Work Restrictions: Comply with restrictions on construction operations. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On Site Work Hours: Limit Work in the existing building to normal working hours, Monday through Friday, unless otherwise indicated. Coordinate with Owner when it is necessary to extend working hours or Work on weekends.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and after providing temporary utility services according to requirements indicated:
1. Notify Owner not less than two weeks in advance of proposed utility interruptions.
2. Obtain Owner’s written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
1. Notify Owner not less than two weeks in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Controlled Substances, Firearms, and Explosive Devices: Use of tobacco products, controlled substances, firearms, and explosive devices on the site is not permitted.

F. Employee Identification: Provide identification tags for Contractor personnel working on site. Require personnel to use identification tags at all times.

G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on site.
1. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 1 General Requirements: Requirements of Sections in Division 1 apply to the Work of each specification section.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE

A. The Owner has a critical need for the Work to begin upon Notice to Proceed and shall be Substantially Complete by **Fall 2026.** There will be No Extensions of Time due to weather.

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements governing allowances.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include:
   1. Lump sum allowances.
   2. Unit cost allowances.
   3. Quantity allowances.
   4. Contingency allowances.
   5. Testing and inspecting allowances.

1.3 COORDINATION

A. Coordinate allowance items with other portions of the Work.

1.4 LUMP SUM, UNIT COST, AND QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight**,** and delivery to site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

   1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.5 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation**,** taxes, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.6 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of services not required by the Contract Documents are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.7 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   1. Include installation costs in purchase amount only where indicated as part of the allowance.
   2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
   3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
   4. Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
   1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
   2. No change to Contractor's indirect expense is permitted for selection of higher or lower priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related Work.

3.3 SCHEDULE OF ALLOWANCES

A. Owner's Contingency Allowance (lump sum): $900,000.00
   1. Offerors shall include the allowance amount indicated in their Base Proposals as a contingency allowance to cover costs attributable to hidden, concealed or otherwise unforeseen conditions which become apparent during operations under this Contract. The Contractor shall be allowed to recover all direct costs associated with the completion of work authorized under this allowance; however, no Contractor's overhead or profit will be allowed.

B. Interior Printed and Custom Painted Graphics Allowance (lump sum): $75,000.00
   1. Offerors shall include the allowance amount indicated in their Base Proposals for design and execution of interior custom painted and custom printed decorative graphics on interior surfaces at multiple locations as indicated in the Contract Documents and to be determined by Architect. This does not include graphics included in the Base contract amounts as already indicated in the drawings and specifications. Allowance amount includes labor, materials, accessories, and other associated and incidental costs, except Contractor's overhead and profit. Offerors shall include in their Base Proposals, but not in the allowance, Contractor's overhead and profit on custom painted graphics work.

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:
   1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
   2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
   1. Description: Unsatisfactory soil excavation and disposal off site and replacement with satisfactory fill material or engineered fill from off site, as required, according to Section 312000 "Earth Moving."
   2. Unit of Measurement: Cubic yard of soil excavated, based on survey of volume removed.
   3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."

B. Unit Price No. 4: Concrete
   1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new cement stabilized sand and lean concrete material delivered, spread, and compacted per plans and specs. Cost shall include all materials and labor for complete installation. Enter unit cost on Proposal form.

C. Unit Price No. 5: Select Fill
   1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new select fill material, delivered, spread, and compacted per plans and specs. Cost shall include all materials and labor for complete installation. Enter unit cost on Proposal Form.

D. Unit Price No. 6: Spread Footing (Add)
   1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) spread footing of each footing size utilized in the project per 1/S-303. Cost shall include all materials and labor for complete installation. Enter unit cost for each footing size on Proposal Form.

E. Unit Price No. 7: Spread footing (Deduct)
   1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) spread footing of each footing size utilized in the project per 1/S-303. Cost shall include all materials and labor for complete installation. Enter unit cost for each footing size on Proposal Form.

F. Unit Price No. 8: Miscellaneous and structural steel.
   1. Description: Miscellaneous lintels and other supports not otherwise indicated in the Contract Documents, according to Section 051200 "Structural Steel Framing" and Section 055000 "Metal Fabrications."
   2. Unit of Measurement: Cost in place of pounds of fabricated steel as indicated on itemized invoice of steel supplier and verified by Architect.

END OF SECTION 01 22 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes: Administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain Work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. Alternates described are part of the Work when enumerated in the Agreement.
   2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent Work as necessary to completely integrate Work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Forty-eight (48) hours following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other Work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate Number 1: 23 09 23 – Direct Digital Controls – **Automated Logic Corporation**
   1. This Alternate shall establish the amount to adjust the Base Proposal for the cost of furnishing and installing Direct Digital Controls manufactured by Automated Logic Corporation; WEBCTRL® – Installed by **Automated Logic Corporation (ALC) – Houston**. This alternate shall include the pricing for all materials and labor for proper completion. Refer to specs and drawings for additional information.

B. Alternate Number 2a: 23 52 16 – Condensing Boilers - **RBI**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Condensing Boilers, manufactured by **RBI – Flexcore model** as shown and scheduled on the drawings and as specified. Alternate boiler price shall include warranty as specified per 1.9.

C. Alternate Number 2b: 23 52 16 – Condensing Boilers - **Raypak**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Condensing Boilers, manufactured by **Raypak – XVERS model** as shown and scheduled on the drawings and as specified. Alternate boiler price shall include warranty as specified per 1.9.

D. Alternate Number 2c: 23 52 16 – Condensing Boilers – **Patterson - Kelley**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Condensing Boilers, manufactured by **Patterson-Kelley – Sonic model** as shown and scheduled on the drawings and as specified. Alternate boiler price shall include warranty as specified per 1.9.

E. Alternate Number 2d: 23 52 16 – Condensing Boilers - **Camus**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Condensing Boilers, manufactured by **Camus – Avenger model** as shown and scheduled on the drawings and as specified. Alternate boiler price shall include warranty as specified per 1.9.

F. Alternate Number 3a: 23 64 23 – Scroll Water Chillers Air-Cooled – **Trane**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Scroll Water Chillers Air-Cooled, manufactured by **Trane** as shown and scheduled on the drawings and as specified. Alternate chiller price shall include (5) five-year parts, labor, refrigerant, etc. extended warranty (re: 1.10 Warranty) as well as (5) five-year Preventative Maintenance Service (re: 1.11 Preventative Maintenance Service); there are no chillers included in the base bid.

G. Alternate Number 3b: 23 64 23 – Scroll Water Chillers Air-Cooled – **Carrier**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Scroll Water Chillers Air-Cooled, manufactured by **Carrier** as shown and scheduled on the drawings and as specified. Alternate chiller price shall include (5) five-year parts, labor, refrigerant, etc. extended warranty (re: 1.10 Warranty) as well as (5) five-year Preventative Maintenance Service (re: 1.11 Preventative Maintenance Service); there are no chillers included in the base bid.

H. Alternate Number 3c: 23 64 23 – Scroll Water Chillers Air-Cooled – **JCI**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Scroll Water Chillers Air-Cooled, manufactured by **JCI** as shown and scheduled on the drawings and as specified. Alternate chiller price shall include (5) five-year parts, labor, refrigerant, etc. extended warranty (re: 1.10 Warranty) as well as (5) five-year Preventative Maintenance Service (re: 1.11 Preventative Maintenance Service); there are no chillers included in the base bid.

I. Alternate Number 4a: 23 74 13.16 – Packaged, Outdoor, Central-Station Hydronic Air-Handling Units – **Carrier**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Packaged, Outdoor, Central-Station Hydronic Air- Handling Units, manufactured by **Carrier** as shown and scheduled on the drawings and as specified; there are no Packaged, Outdoor, Central -Station Hydronic Air-Handling Units included in the base bid.

J. Alternate Number 4b: 23 74 13.16 – Packaged, Outdoor, Central-Station Hydronic Air-Handling Units – **Trane**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Packaged, Outdoor, Central-Station Hydronic Air- Handling Units, manufactured by **Trane** as shown and scheduled on the drawings and as specified; there are no Packaged, Outdoor, Central -Station Hydronic Air-Handling Units included in the base bid.

K. Alternate Number 4c: 23 74 13.16 – Packaged, Outdoor, Central-Station Hydronic Air-Handling Units – **JCI**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Packaged, Outdoor, Central-Station Hydronic Air- Handling Units, manufactured by **JCI** as shown and scheduled on the drawings and as specified; there are no Packaged, Outdoor, Central -Station Hydronic Air-Handling Units included in the base bid.

L. Alternate Number 4d: 23 74 13.16 – Packaged, Outdoor, Central-Station Hydronic Air-Handling Units – **Temtrol**
   1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Packaged, Outdoor, Central-Station Hydronic Air- Handling Units, manufactured by **Temtrol** as shown and scheduled on the drawings and as specified; there are no Packaged, Outdoor, Central -Station Hydronic Air-Handling Units included in the base bid.

M. Alternate Number 5: Provide metal stud partition assemblies and accessories in lieu of Integrated Interior Assemblies (Section 13 42 75) per guidelines listed below:

   1. Provide gypsum board assemblies per Section 09 21 16.
      a. Partition: 25 ga. metal studs at 16" O.C., width to match width of assembly framing. One layer of 5/8" impact resistant type "x" gyp. board on each side with sound attenuation blanket, STC 45. Wall base to match scheduled flooring with continuous acoustical sealant on both sides.
   2. Wall Finish:
      a. Ceramic Wall tile up to 7’-0” at Corridor side.
         i. Manufacturer: Crossville Studios - Urbanology by Stile
         ii. Color: WT-3 Metropolis chiseled & WT-4 Titanium Chiseled
         iii. Size: 24”X48”
      b. Ceramic Wall tile at Restrooms.
         i. Manufacturer: WT-5, WT-6 & WT-7 Esmer - Raku
         ii. Color: White - Size: 3”x12” Matte
         iii. Color: Charcoal // Mustard - Size: 3”x12” Glossy
      c. Ceramic Wall tile at Stairwell (2-Story)
         i. Manufacturer: Crossville Studios - Urbanology by Stile
         ii. Color: WT-3 Metropolis chiseled & WT-4 Titanium Chiseled
         iii. Size: 24”X48”
      d. Glass Mirrors - Annealed Float Glass.
         i. Clear, ASTM C1036, with copper and silver coatings, and protective overcoating.
            a. Thickness: 1/4 inch (6.4 mm).
            b. Edges: Arrised.
            c. Size: As indicated on Drawings.

3. Provide aluminum framed storefronts per Section 08 43 13 at all window and door locations.
    a. 6'-10" door frame with transom above – height to match scheduled ceiling
    b. 1 3/4" thick, plastic clad, solid core wood doors.
    c. Anodized aluminum frame, typical
    d. Window glazing and frame: Anodized aluminum frame, typical and 1/4" thick clear tempered glass
4. Tack boards – Vinyl mounted on resilient cork underlay, 1/2" thick.
    a. Basis of Design: Claridge Fabricork series #1550EW or comparable product.
    b. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
    c. Color and Pattern: Selected by Architect.
5. Marker Boards with multimedia finish and aluminum tray and trim (magnetic).
    a. 24-gauge porcelain enamel steel LCS 24 face sheet on 7/16 inch MDF core with 0.015 inch aluminum back sheet. Color: White & Magnetic.
6. Educational Casework:
    a. Manufactured plastic laminated casework, hardware and related accessories.
    b. Identification of casework components and related products by surface visibility.
        i. Balanced construction: High pressure laminate or cabinet liner shall be installed on both sides of core to restrict warpage in accordance with AWI Quality Standards Illustrated Section 400B-T-2.
        ii. Open Interiors: Open unit without solid door and drawer fronts, and units with full glass insert or acrylic doors.
        iii. Closed Interiors: Closed unit behind solid door, drawer fronts, and sliding solid doors.
        iv. Exposed Ends: Exterior side surface that is visible after installation.
        v. Other Exposed Surfaces: Faces of doors and drawers when closed and tops of cabinets less than 72 inches above finished floor.
        vi. Semi-Exposed Surfaces: Interior surfaces which are visible, bottoms of wall cabinets and tops of cabinets 72 inches or more above finished floor.
        vii. Concealed Surfaces: Any surface not visible after installation.
7. Electrical Work Scope:
    a. Refer to 26 05 00 - Common Work Results for Electrical
    b. Provide all work for electrical systems required in the project to be properly installed, tested and performing their intended function. Coordinate the work of this division with all other divisions to ensure that all components of the electrical system will be installed at the proper time and fit the available space. Locate and size all openings in work of other trades required for the proper installation of the electrical system components. Make all electrical connections to all equipment furnished by this division and any other division. Make all electrical connections from all 120 volt and greater dampers and switches to associated exhaust fan(s) furnished by any other division.
8. Plumbing Work Scope:
    a. Refer to 22 05 00 – Common Work Results for Plumbing
    b. Plumbing systems installed, and the work performed under Division 22 of the
    c. Specifications, shall include, but are not necessarily limited to connection points for all systems from the site utilities shall be at 5'-0" from the exterior of the building unless specifically noted otherwise. Provide all work for

plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

9. Technology Work Scope:
   a. Refer to 27 00 00 - Basic Materials and Methods
   b. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. Provide an extension of the existing installed systems interfaced with new systems in the newly constructed building, complete in every respect.

END OF SECTION 01 23 00

SECTION 01 25 13 - PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Specified product compliance, and product quality assurance.

B. Specific administrative and procedural requirements for handling requests for substitutions made prior to award of Contract.

C. Requirements for product delivery, storage and handling.

1.3 RELATED REQUIREMENTS

A. Instructions to Offerors: Product options and procedures for submittal of requests for substitutions during the Proposal period.

1.4 DESCRIPTION OF REQUIREMENTS

A. Definitions: Definitions used in this Section are not intended to negate the meaning of other terms used in the Contract Documents, including such terms as “specialties”, “systems”, “structure”, “finishes”, “accessories”, “furnishings”, “special construction”, and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.

1. Products: Shall mean items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the project or taken from the Contractor’s previously purchased stock. The term “product” as used herein includes the terms “material”, “equipment”, “system”, and other terms of similar intent.
    a. Named Products: Are those identified by the use of the manufacturer’s name for a product, including such items as a make or model designation, as recorded in published product literature, of the latest issue as of the date of the Contract Documents.
    b. Specified Products: same as Named Products.

2. Materials: Shall mean products that must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form units of work.
3. Equipment: Is defined as a product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

1.5 PRODUCT QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.

1. When it is discovered that specific products are available only from sources that do not or cannot produce an adequate quantity to complete project requirements in a timely manner, consult with the Architect/Engineer for a determination of what product quantities are most important before proceeding. The Architect/Engineer will designate those qualities, such as visual, structural, durability, or compatibility, that are most important. When the Architect/Engineer’s determination has been made, select products from those sources that produce products that possess the most important qualities, to the fullest extent possible.

B. Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two (2) or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.

C. Or Equal:
   1. Where the phrase “or equal”, “or equivalent”, “or Architects approved equal”, or similar phrasing, occurs in the Proposal Documents, do not assume that materials, equipment, or methods of construction will be approved by the Architect unless the item has been specifically approved for this Work by the Architect.
   2. The decision of the Architect shall be final.

D. Where a proposed substitution involves the work of more than one (1) contractor, each contractor involved shall cooperate and coordinate the work with each other contractor involved, so as to provide uniformity and consistency and to assure the compatibility of products.

E. Foreign Product Limitations: “Foreign products” as distinguished from “domestic products” are defined as products that are either manufactured substantially (50 percent or more of value) outside of the United States and its possessions, or produced or supplied by entities known to be substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.
   1. Except under one (1) of the following conditions, select and provide domestic, not foreign, products for inclusion in the Work.
      a. There is no domestic product available that complies with the requirements of the Contract Documents.
      b. Available domestic products that comply with the requirements of the Contract Documents are available only at prices or other procurement terms that are substantially higher (25 percent or more) than for available foreign products that comply with the requirements of the Contract Documents.
      c. At the discretion of the Architect or Owner.

   2. Final determination and acceptance will be the responsibility of the Architect.

F. Standards: Refer to Section 01 41 00, Regulatory Requirements for the applicability of industry standards to the products specified for the Project, and for the acronyms used in the text of the Specification Sections.

1.6 SUBSTITUTIONS OF PRODUCTS

A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.

B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least seven (7) days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

C. If the Architect approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.

D. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final

E. The following are not considered as substitutions:
   1. Revisions to the Contract Documents, when requested by the Owner, Architect, or any of their consultants are considered as “changes” not substitutions.
   2. Specified Contractor options on products and construction methods included in Contract Documents are choices made available to the Contractor and are not subject to the requirements specified in this Section for substitutions.
   3. Except as otherwise provided in the Contract Documents, the Contractor’s determination of and compliance with governing authorities do not constitute “substitutions” and do not constitute a basis for change orders.

F. The following may be considered as a reason for a request for substitution:
   1. The request is directly related to an “or approved equal” clause or similar language in the Contract Documents.
   2. The specified product or method of construction cannot be provided within the Contract Time in accordance with paragraph below concerning availability of specified items.
   3. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
   4. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other consideration of merit, after deducting offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Architect/Engineer for redesign and evaluation services, the increased cost of other work by the Owner or separate contractors, and similar considerations.
   5. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
   6. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
   7. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.

G. Availability of specified items:
   1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
   2. In the event specified items will not be so available, notify the Architect prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
   3. The request will not be considered if the product or method cannot be provided as a result of the Contractor’s failure to pursue the work promptly or coordinate activities properly.
   4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.

H. A request constitutes a representation that Offeror:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.

I. **No substitutions will be considered after the Award of Contract.**

1.7 SUBSTITUTION REQUEST SUBMITTAL

A. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
   1. Product data, drawings and descriptions of products, fabrication and installation procedures.
   2. Samples, where applicable or requested.
   3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
   4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
   5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
   6. Cost information, including a proposal of the net change, if any in the Contract Sum.
   7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
   8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.

B. Work-Related Submittals: The Contractor's submittal of, and the Architect/Engineer's acceptance of, Shop Drawings, Product Data, or Samples which are related to work not complying with the Contract Documents, does not constitute an acceptance or valid request for a substitution, nor approval thereof.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control to prevent overcrowding of construction spaces or overloading of structure. In particular, coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.
   1. Deliver products to the site in the manufacturer's sealed containers or other packaging system, complete with labels intact, and instructions for handling, storage, unpacking, installing, cleaning and protecting.

2. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.
3. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
4. Store products at the site or in a bonded and insured off-site storage facility or warehouse in a manner that will facilitate inspection and measurement of quantity or counting of units. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
5. Store heavy materials away from the project structure or in a manner that will not endanger the supporting construction.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCE

A. General: Requirements for individual products are indicated in the Contract Documents; compliance with these requirements is in itself a contract requirement. These requirements may be specified in any one (1) of several different specifying methods, or in any combination of these methods. These methods include the following:
   1. Proprietary.
   2. Descriptive.
   3. Performance.
   4. Compliance with Reference Standards.

B. Compliance with codes, compliance with graphic details, allowances, and similar provisions of the Contract Documents also have a bearing on the selection process

C. Procedures for Selecting Products: The Contractor's options in selecting products are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include, but are not limited to the following for the various indicated methods of specifying:
   1. Proprietary and Semi-Proprietary Specification Requirements:
      a. Single Product Name: Where only a single product or manufacturer is named, provide the product indicated, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding, when it is discovered that the named product is not a reasonable or feasible solution.
      b. Two (2) or More Product Names: Where two (2) or more products or manufacturers are named, provide one (1) of the products named, at the Contractor's option. Exclude products that do not comply with specification requirements. Do not provide or offer to provide an unnamed product, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding where none of the named products comply with specification requirements, or are not feasible for use. Where products or manufacturers are specified by name, accompanied by the term "or approved equal" or similar language, comply with this Section regarding "substitutions" to obtain approval from the Architect/Engineer for the use of an unnamed product.
   2. Non-Proprietary Specification Requirements: Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with the Contract requirements.
   3. Descriptive Specification Requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand name, provide products or assemblies that provide the characteristics indicated and otherwise comply with Contract requirements.

4. Performance Specification Requirements: Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performances.
5. Compliance with Standards, Codes, and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including standards, codes, and regulations.
6. Visual Matching: Where matching an established sample is required, the final judgement of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Architect. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of this Section regarding "substitutions" and other Contract Documents for "change orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.
7. Visual Selection: Except as otherwise indicated, where specified product requirements include the phrase "…as selected from the manufacturer's standard colors, patterns, textures…" or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Architect is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.
8. Allowances: Refer to individual sections of the specifications and Section 01 21 00, Allowances for an indication of product selections that are controlled by established allowances, and for the procedures required for processing such selections.

D. Producer's Statement of Applicability: Where individual specification sections indicate products that require a "Statement of Applicability" from the manufacturer or other producer, submit a written-certified statement from the producer stating that the producer has reviewed the proposed application of the product on the project. This statement shall state that the producer agrees with or does not object to the Architect/Engineer's specification and the Contractor's selection of the product on the project is suitable and proper.

2.2 SUBSTITUTIONS

A. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated.

B. Anchor each product securely in place, accurately located and aligned with other work.

C. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.

D. Products and assemblies shall be installed complete, in-place, watertight and structurally sound.

3.2 INSTALLATION OF APPROVED SUBSTITUTIONS

A. Coordinate all approved substitutions with adjacent work.

B. Comply with the manufacturer's and/or supplier's instructions and recommendations for installation of the products in the applications indicated.

C. Provide all items required by manufacturer and/or supplier regarding installation, i.e. supplemental supports, anchors, fasteners, painting, etc. whether or not indicated or specified.

END OF SECTION 01 25 13

REQUEST FOR SUBSTITUTION

Contract Award Date: _____

To: _____

Substitution Requested By: _____

Project Name and Number: _____

We submit for consideration the following product in lieu of the specified item for the above project:

Drawing No.	Specification Section	Paragraph	Specified Item
_____	_____	_____	_____

Proposed Substitution: _____

Request is made during ____ bidding _____ construction period.

Submit in accordance with Section 01 33 00.

1. Technical data, cost, and time information relating to changes to Construction Documents required by proposed substitution.
2. Detailed comparison of proposed substitution and specified product including but not limited to warranty, significant variations, qualifications of manufacturers, and maintenance.
3. Complete technical data, detailed shop drawings, samples, installation procedures, warranty, and substantiating data marked to indicate equivalent quality and performance to that specified. Manufacturer sell sheets are not acceptable submittals.

Cause for Request: _____

Cost saving realized by Owner _____

Does substitution affect adjacent Work, Construction Documents, cost, schedule, quality, and related submittals?

Yes _____ No ____ On separate sheet, explain affects to the Work, documents, schedule, and submittals.

The Contractor is responsible for associated costs and additional time of the proposed substitution including costs incurred by the Architect for evaluation of substitution and changes to the documents. Describe costs for changes to design, including engineering and detailing costs caused by the requested substitution.

_____

_____

Warranty: Is the warranty for the requested substitution the same or different? Yes _____ No _____

Explain Differences: _____

Contractor Certification:

In making a request for substitution, the Contractor certifies that:

1. The proposed substitution has been thoroughly researched and evaluated and determined as equivalent or superior to specified product or material, will fit into space provided, and is compatible with adjacent materials.
2. It will provide the same or better warranty for the proposed substitution at no additional cost to the Owner.

3. Cost data is complete and includes related costs under the Contract. Claims for additional costs related to the proposed substitution that may subsequently become apparent are waived.
4. It will assume the responsibility for delays and costs caused by the proposed substitution, if approved, are accepted by the Contractor unless delays are and costs are specifically mentioned and approved in writing by the Owner and the Architect.
5. It will assume the liability for the performance of the substitution and its performance.
6. The installation of the proposed substitution is coordinated with the Work and with changes required for the Work.
7. It will reimburse the Owner and Architect for evaluation and redesign services associated with the substitution request and, when required, by approval by governing authorities.

Submitted by:

_____

Signature of Contractor Title

_____

Firm Telephone Date

Signature shall be by the individual authorized to legally bind the Contractor's to the above terms. Failure to provide legally binding signature will result in retraction of approval.

FOR USE BY ARCHITECT:

____ Accepted ____ Accepted as Noted
____ Not Accepted ____ Received Too Late

By: _____

Date: _____

Remarks: _____

FOR USE BY OWNER:

____ Accepted ____ Not Accepted

By: _____

By: _____

Remarks: _____

END OF SECTION 01 25 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for handling and processing Contract modifications.

B. Related Work:
   1. Section 01 25 13 – Product Substitution Procedures.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 *Architect's Supplemental Instructions*.

1.4 PROPOSAL REQUESTS

A. Owner Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Work Change Proposal Requests issued by Architect are not instructions either to stop Work in progress or to execute the proposed change.
   2. After receipt of Proposal Request, submit quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and supervision directly attributable to the change.
      d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
   1. Include statement outlining reasons for the change and the effect of the change on the Work. Provide complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
   2. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   4. Include costs of labor and supervision directly attributable to the change.
   5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times,

and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Section 01 25 00 if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use AIA Document G709.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: When an allowance is specified, refer to Section 01 21 00 for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1. Allowance Adjustment: To adjust allowance amounts, base each Change Proposal Request (CPR) on the difference between purchase amount and the allowance, multiplied by final measurement of Work in place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
    a. Include installation costs in purchase amount only where indicated as part of the allowance.
    b. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
    c. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
    d. Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.

2. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 7 days of receipt of the Change Order authorizing work to proceed. Owner will reject claims submitted later than 7 days after authorization.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will execute a Change Order also requiring signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work and designates the method to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of Work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

B. Pencil Copy: A preliminary review copy of the application for payment for review by Architect and Owner prior to submission of final copy.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
   1. Coordinate line items in the schedule of values with administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Updated Submittal schedule.
      c. Items required to be indicated as separate activities in updated Contractor's construction schedule.

   2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment. Contractor's standard form or electronic media printout will be considered but must be approved by the Owner.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the schedule of values:
      a. Project name and location.
      b. Name of Architect.
      c. Architect's project number.
      d. Contractor's name and address.
      e. Date of submittal.

   2. Arrange schedule of values consistent with format of AIA Document G703.

   3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
      a. Related Specification Section or Division.
      b. Description of the Work.
      c. Name of subcontractor.
      d. Name of manufacturer or fabricator.
      e. Name of supplier.

      f. Change Orders (numbers) that affect value.

g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
   1) Labor.
   2) Materials.
   3) Equipment rentals.
   4) General Conditions.
      a. Supervisor.
      b. Submittals.
      c. Close-out.
      d. Field Engineering.
      e. Daily Clean-up.
      f. Final Clean-up.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Provide separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on site and items stored off site. Include evidence of insurance.

6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line item value of unit cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
   a. Temporary facilities and other major cost items that are not direct cost of actual Work in place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Submit preliminary (pencil) copy of proposed values to Architect or Architects field representative and Owner for review by 20th date of the month. Allow 48 hours for comments.

B. Once preliminary (pencil) approved, submit electronic copy of notarized originals of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702 or other similar form approved by the Owner.

C. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.

D. Submit updated construction or recovery schedule with each Application for Payment.

E. Payment Period: Submit at intervals stipulated in the Agreement in accordance with Document 00 73 00, Supplementary Conditions of the Contract.

F. Only materials stored on the project site shall be paid for unless the materials are stored in a bonded warehouse.

G. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Items which may be requested by the Architect or Owner to substantiate costs include, but are not limited to the following:
   a. Current Record Documents as specified in Section 01 77 00, Closeout Procedures maintained.

1. Labor time sheets, purchase orders, or similar documentation.
2. Affidavits attesting to off-site stored products.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 29 00

SECTION 01 29 73 - SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. Work Included: Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the work, as specified herein and in other provisions of the Contract Documents.

B. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning Schedule of Values.

1.3 QUALITY ASSURANCE

A. Use required means to assure arithmetical accuracy of the sums described.

B. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner, substantiating the sums described.

1.4 SUBMITTALS

A. Prior to the first Application for Payment, submit a proposed schedule of values to the Owner, as outlined below:
   1. Meet with the Owner and determine additional data, if any, required to be submitted.
   2. Secure the Owner's approval of the schedule of values prior to submitting first Application for Payment.

1.5 SCHEDULE OF VALUES

A. The Schedule of Values shall be broken down into item costs for each specification section as a minimum. After review by the Owner, the Schedule of Values shall be broken down into further items as required. (See following list and refer to the enclosed sample.). In addition, total each Specification Division separately.

B. Schedule of Values - Items in addition to Specification Sections.
   1. Mobilization
   2. Clean Up
   3. Building Permit
   4. Bonds, Insurance
   5. Misc. Mechanical Accessories
   6. Demolition
   7. Rough-In Labor - (Electrical)
   8. Rough-In Material - (Electrical)
   9. Finish Labor - (Electrical)
   10. Finish Material - (Electrical)
   11. Allowances (listed separately)
   12. Record drawings and close-out documents
   13. Submittals listed separately per mechanical, electrical and plumbing

14. Roof warranty as a line item
15. Donated items individually itemized at $0.00 (zero dollars).

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 SCHEDULE OF VALUES

A. Refer to following sample.

END OF SECTION 01 29 73

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Div. 1 - General Reqs.								
	Site Work General Conditions								
	Supervision								
	Mobilization								
	Bonds & Insurance								
	Permits								
	Contractor's Fee								
	Close-Out Documents								
	Div. 1 - Total								
	Div. 2 - Existing Conditions								
	Demolition (As applicable)								
	Erosion Control								
	Div. 2 - Total								
	Div. 3 - Concrete								
	Drill Piers								
	Caps & Beams								
	Slab on Grade								
	Cooling Tower Basin								
	Misc Bldg Conc								
	Floor Sealer								
	Rebar Matl								
	Rebar Labor								
	Lt.Wt.Insul Fill - Materials								
	Lt.Wt.Insul Fill - Labor								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 3 - Total								
	Div 4 - Masonry								
	Brickwork - Labor								
	Brickwork - Matls								
	Concrete Masonry - Labor								
	Concrete Masonry - Materials								
	Str. Glazed Tile-Labor								
	Str. Glazed Tile-Materials								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 4 - Total								
	Div 5 - Metals								
	Structural Steel - Labor								
	Structural Steel - Materials								
	Alternating Stairs								
	Misc. Steel - Materials								
	Steel Joists - Materials								
	Lt. Gauge Steel Framing-Labor								
	Lt. Gauge Steel Framing-Matls								
	Metal Decking - Labor								
	Expansion Joint Covers								
	Metal Decking - Matls								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Detailing								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 5 - Total								
	Div. 6 - Wood & Plastics								
	Rough Carpentry - Labor								
	Rough Carpentry - Materials								
	Millwork - Labor								
	Millwork - Materials								
	Submittals/Close-Out Documents								
	Div. 6 - Total								
	Div. 7 - Thermal and Moisture Protection								
	Waterpfng / Dampprfng-Matls								
	Waterpfng / Dampprfng-Labor								
	Building Insulation - Labor								
	Building Insulation - Materials								
	Fireproofing - Labor								
	Fireproofing - Materials								
	Metal Roof - Labor								
	Metal Roof - Materials								
	Metal Roof Guarantee								
	Built-up Roofing-Labor								
	Built-up Roofing-Materials								
	Built-up Roofing Guarantee								
	Roof Accessories								
	Building Sheet Metal - Labor								
	Building Sheet Metal - Matls								
	Bldg. Sheet Metal Guarantee								
	Roof Curbs								
	Roof Hatches								
	Sealants								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 7 - Total								
	Div. 8 - Doors and Frames								
	Finish Carpentry/Door - Labor								
	Finish Hardware - Matls								
	Thresholds & Seals - Matls+B66								
	Hollow Metal Doors & Frames - Matls								
	Plastic Faced Doors-Matls								
	Overhead Doors & Grilles-Labor								
	Overhead Doors & Grilles - Matls								
	Alum. Entrances & Store-fronts - Labor								
	Alum. Entrances & Store-								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	fronts - Matls								
	Alum. Windows - Labor								
	Alum Windows - Matls								
	Glass & Glazing-Labor								
	Glass & Glazing-Matls								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 8 - Total								
	Div. 9 - Finishes								
	Lath & Plaster-Labor								
	Lath & Plaster-Matls								
	Gypsum Wallboard								
	Systems - Labor								
	Gypsum Wallboard								
	Systems - Matls								
	Ceramic Tile - Labor								
	Ceramic Tile - Matls								
	Quarry Tile - Labor								
	Quarry Tile - Matls								
	Terrazzo-Labor								
	Terrazzo-Matls								
	Acoustic Clg. - Labor								
	Acoustic Clg. - Matls								
	Acoustic Wall Panels								
	Resilient Flooring - Labor								
	Resilient Flooring - Matls								
	Carpet - Labor								
	Carpet - Matls								
	Athletic Flooring - Materials								
	Athletic Flooring - Labor								
	Floor Sealer								
	Painting - Labor								
	Painting - Mtls								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 9 - Total								
	Div. 10 - Specialties								
	Visual Display Boards &								
	Tackboards - Materials								
	Visual Display Boards &								
	Tackboards - Labor								
	Toilet Partitions - Labor								
	Toilet Partitions - Matls								
	Louvers								
	Aluminum Flag Pole								
	Graphics								
	Lockers								
	Cubicle Curtains & Track								
	Fire Extinguisher Cabinets								
	Demountable Partitions-Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Demountable Partitions-Matls								
	Shelving								
	Toilet Room Accessories-Matls								
	Toilet Room Accessories-Lbr								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 10 - Total								
	Div. 11 - Equipment								
	Stage Curtains								
	Misc. Appliances								
	Food Service Eqpt-Labor								
	Food Service Eqpt-Matls								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 11 - Total								
	Div. 12 - Furnishings								
	Horizontal Blinds								
	Projection Screens								
	Casework - Labor								
	Casework - Matls								
	Science Casework - Labor								
	Science Casework - Matls								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 12 - Total								
	Div. 13 - Specialties								
	Stage Curtains and Draperies								
	Music Instrument Storage								
	Bleachers								
	Press Box								
	Pre-eng. Metal Bldg.								
	Stadium Seating								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 13 - Total								
	Div. 14 - Conveying Systems								
	Platform Lifts								
	Elevators								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 14 - Total								
	Div. 21, 22 - Plumbing								
	Shop Drawings								
	As-Builts/Close-Out/ O&M Manuals								
	Sanitary Underground -								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Labor								
	Sanitary Underground - Matls								
	Storm Underground - Labor								
	Storm Underground - Matls								
	Domestic Water - Labor								
	Domestic Water - Matls								
	Plumbing Insulation - Matls								
	Plumbing Insulation - Labor								
	Gas Piping - Matls								
	Gas Piping - Labor								
	Grease Trap								
	Plumbing Fixtures - Matls								
	Plumbing Fixtures - Labor								
	Coordination Drawings								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 21, 22 Plumbing - Total								
	Div. 23 - Mechanical								
	Shop Drawings								
	As-Builts/Close-Out/ O&M Manuals								
	Chillers - Matls								
	Chillers - Labor								
	Cooling Towers - Matls								
	Cooling Towers - Labor								
	Boilers - Matls								
	Boilers - Labor								
	AHU's - Matls								
	AHU's - Labor								
	Fans - Matls								
	Fans - Labor								
	Grilles - Matls								
	Grilles - Labor								
	Ductwork - Matls								
	Ductwork - Labor								
	Pumps - Mtls								
	Pumps - Labor								
	Water Treatment - Labor								
	Water Treatment - Matls								
	Isolation - Labor								
	Isolation - Matls								
	Pipe Flex - Matls								
	Pipe Flex - Labor								
	Connections								
	Sheet Metal - Matls								
	Sheet Metal - Labor								
	Duct Insulation - Matls								
	Duct Insulation - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Pipe Insulation - Matls								
	Pipe Insulation - Labor								
	VAV Boxes - Materials								
	VAV Boxes - Labor								
	Refrigerant Monitor - Matls								
	Refrigerant Monitor - Labor								
	Unit Heaters - Materials								
	Unit Heaters - Labor								
	Startup								
	Controls - Matls								
	Control - Labor								
	Engineer / Submittals								
	Modules / End Devices								
	Low Voltage Wiring								
	Startup								
	Close-Out Documents								
	Fire Sprinkler								
	Engineer / Submittals								
	Piping - Materials								
	Piping - Labor								
	Equipment - Materials								
	Equipment - Labor								
	Trimout - Materials								
	Trimout - Labor								
	Pipe, Valves, Fittings - Labor								
	Pipe, Valves, Fittings - Matls								
	Misc. - Matls								
	Insulation - Matls								
	Insulation - Labor								
	Sanitary Above Slab-Labor								
	Sanitary Above Slab-Matls								
	Storm Above Slab - Labor								
	Storm Above Slab - Matls								
	Gas - Labor								
	Gas - Matls								
	Fixtures - Labor								
	Fixtures - Matls								
	Permits								
	Coordination Drawings								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 23 Mechanical - Total								
	Div. 26 - Electrical								
	Mobilization+B220								
	Shop Drawings								
	As-Builts/Close-Out/ O&M Manuals								
	Underground								
	Conduit - Labor								
	Conduit - Matl								
	Wire - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Wire - Matls								
	Feeder Wire - Labor								
	Feeder Wire - Matls								
	Switches/Recpt.								
	Switchgear - Labor								
	Switchgear - Matls								
	Temporary - Materials								
	Temporary - Labor								
	Gas Generator - Materials								
	Gas Generator - Labor								
	Fixtures - Labor								
	Fixtures - Matls								
	Communications - Labor								
	Communications - Matls								
	Fire Alarm - Labor								
	Fire Alarm - Matls								
	Security - Labor								
	Security - Matls								
	Low Voltage Ltng Sys-Matls								
	Low Voltage Ltng Sys-Labor								
	Voice System - Materials								
	Voice System - Labor								
	Video System - Materials								
	Video System - Labor								
	Data System - Materials								
	Data System - Labor								
	Master Clock - Materials								
	Master Clock - Labor+B277								
	Coordination Drawings								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 26 - Total								
	Divs. 31, 32 and 33 - Earthwork, Exterior Improvements and Utilities								
	Site Clearing & Grubbing								
	Building Pad - Materials								
	Building Pad - Labor								
	Paving Subgrade								
	Signage / Striping								
	Bike Racks								
	Landscaping - Materials								
	Landscaping - Labor								
	Hydro Mulch - Materials								
	Hydro Mulch - Labor								
	Irrigation - Materials								
	Irrigation - Labor								
	Earthwork								
	Finish Grading								
	Stabilization - Materials								
	Stabilization - Labor								
	Site Drainage - Materials								
	Site Drainage - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Chain Link Fence-Materials								
	Chain Link Fence-Labor								
	Paving - Labor								
	Paving - Materials								
	Sidewalks								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 31, 32 and 33 - Total								
	General Conditions								
	Mobilization								
	Temp. Facilities								
	Final Cleaning								
	Record Documents/Close-out/ O&M Manuals								
	Supervision								
	Permits								
	Bonds								
	Insurance								
	Allowances								
	Alternates (list)								
	Change Orders								
	A. PR#								
	B. PR#								
	C. PR#								

END OF SECTION

SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. Pre-install meetings.

B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific Contractor.

C. Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. Requests for Information (RFI's) will not be allowed from the Contractor. The Contractor shall arrange the necessary meeting in the field with appropriate Architect's field representative(s) to obtain clarification as needed on items that may need interpretation.

1.3 SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, and telephone number of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
   1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.4 COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each Contractor shall coordinate its construction operations with those of other Contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations, included in different Sections, which depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other Contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate Contractors if coordination of the Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule.
   2. Preparation of the schedule of values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Preinstallation conferences.
   7. Project closeout activities.
   8. Startup and adjustment of systems.
   9. Coordinating inspections and other jurisdictional requirements.
   10. Coordinate OFCI equipment.
   11. Action items and issue logs.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to the Specifications Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
   1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
      a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
      b. Coordinate the addition of trade specific information to the coordination drawings by multiple Contractors in sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
      c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures, ductwork, piping, and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:
   a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
   c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
   d. Location of pull boxes and junction boxes, dimensioned from column center lines.
   e. Floor boxes.

8. Fire Protection System: Show the following:
   a. Locations of standpipes, mains piping, branch lines, pipe drops, sprinkler heads, and inspector test locations.

9. IDF/MDF Rooms: Communications and low voltage (security, data, phone, etc.) audio

10. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
   2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
   3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
      a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
      b. Digital Data Software Program: Drawings are available in Revit.
      c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.6 PROJECT MEETINGS

A. Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
   2. Agenda: Architect to prepare the meeting agenda and distribute the agenda to all invited attendees.
   3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
   4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
   5. Issue logs: Documentation element of software project management and contains a list of ongoing and closed issues of the project.

B. Kick-off & Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.
   1. Conduct the conference to review responsibilities and personnel assignments.
   2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Agenda: Discuss items of significance that affect progress.
   4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
   5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

C. Preinstallation Conferences: Conduct a preinstallation trade conference at site before each construction activity that requires coordination with other construction trades.
   1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Engineer of Record of scheduled meeting dates.
   2. Agenda: Contractor to review progress of other construction activities and preparations for the particular activity under consideration.
   3. Contractor to record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
   4. Reporting: Contractor to distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
6. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Substantial Completion.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

E. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each Contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
    b. Six (6) week look-ahead schedules.

5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

F. Coordination Meetings: Conduct coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
c. Review present and future needs of each Contractor present.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Startup construction schedule.
   2. Contractor's construction schedule.
   3. Construction schedule updating reports.
   4. Daily construction reports.
   5. Material location reports.
   6. Site condition reports.
   7. Special reports.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Resource Loading: The allocation of manpower and equipment necessary for completion of an activity as scheduled.

G. Recovery Schedule: Submittal of a revised critical path method (CPM) schedule and a written plan.

H. Look-ahead Schedule: Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update.

I. Milestones: Measurable and observable and serve as progress markers (flags) but, by definition, are independent of time (have zero durations) therefore no Work or consumption of resources is associated with them.

1.4 SUBMITTALS

A. Submittal Format: Submit required submittals in the following format:
   1. Working electronic copy of schedule file, where indicated.
   2. PDF electronic file.

B. Startup Diagram: Of size necessary to display entire network for entire construction period. Show logic relationship ties for all activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
   1. Submit a working electronic copy of schedule, labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
   3. Total Float Report: List of all activities sorted in ascending order of total float.
   4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at monthly intervals.

G. Material Location Reports: Submit at monthly intervals.

H. Site Condition Reports: Submit at time of discovery of differing conditions.

I. Special Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at site. Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
   1. Review software limitations and content and format for reports.
   2. Verify availability of qualified personnel needed to develop and update schedule.
   3. Discuss constraints, including phasing, Work stages, area separations, interim milestones, and partial Owner occupancy.
   4. Review delivery dates for Owner furnished products.
   5. Review schedule for Work of Owner's separate contracts, if any.
   6. Review submittal requirements and procedures.
   7. Review time required for review of submittals and resubmittals.
   8. Review requirements for tests and inspections by independent testing and inspecting agencies.
   9. Review time required for Project closeout and Owner startup procedures.
   10. Review and finalize list of construction activities to be included in schedule.
   11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from entities involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Time is of the essence to the Owner. Commence Work immediately upon issuance of the Notice to Proceed. There is a critical need for the Work to be substantially complete within the time frame identified in the Agreement.

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion and date of final completion.
   1. Contract completion date shall not be changed by submission of schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each separate area or story as a separate numbered activity for each main element of the Work. Comply with the following:
   1. Activity Duration: Define activities in terms of number of days anticipated.
   2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
   3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
   4. Startup and Testing Time: Include number of days anticipated for startup and testing.
   5. Substantial Completion: Indicate completion of all conditions as in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
   6. Punch List and Final Completion: Include a maximum of 30 days for completion of punch list items and final completion.
   7. Inspections required by Authorities Having Jurisdiction (AHJ).

D. Constraints: Include constraints and Work restrictions indicated in the Contract Documents and show how the sequence of the Work is affected.
   1. Work Restrictions: Show the effect of the following items on the schedule:
      a. Coordination with existing construction.
      b. Limitations of continued occupancies.
      c. Uninterruptible services.
      d. Partial occupancy before Substantial Completion.
      e. Use of premises restrictions.
      f. Provisions for future construction.
      g. Seasonal variations.
      h. Environmental control.
      i. Rain days as indicated in Specification Section 01 10 00 Summary.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Submittals.
   b. Mockups.
   c. Fabrication.
   d. Installation.
   e. Tests and inspections.
   f. Adjusting.
   g. Curing.

E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

F. Six (6) week, lookahead schedule: Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
   1. Unresolved issues.
   2. Unanswered Requests for Information.
   3. Rejected or unreturned submittals.
   4. Notations on returned submittals.
   5. Pending modifications affecting the Work and Contract Time.
   6. Inspections by Authorities Having Jurisdiction (AHJ).
   7. Trade pre-installation conference.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

I. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time impact analysis to demonstrate the effect of the proposed change on the overall project schedule.

J. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
   1. Identification of activities that have changed.
   2. Changes in early and late start dates.
   3. Changes in early and late finish dates.
   4. Changes in activity durations in workdays.
   5. Changes in the critical path.
   6. Changes in total float or slack time.
   7. Changes in the Contract Time.

2.2 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording information concerning events at the site and submit each month to Architect:
   1. List of subcontractors at Project site.
   2. List of separate contractors at Project site.
   3. Approximate count of personnel at Project site.
   4. Rental equipment at Project site.
   5. Material deliveries.
   6. High and low temperatures and general weather conditions, including presence of rain or snow.
   7. Accidents.
   8. Meetings and significant decisions.
   9. Unusual events (see special reports).

10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of Authorities Having Jurisdiction (AHJ).
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report and contact Architect Field Representative. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents to Architect Field Representative.

D. Special Reports: Submit special reports directly to Owner within 24 hours of an occurrence. Distribute copies of report to parties affected by the occurrence.
1. Reporting Unusual Events: When an event of an unusual and significant nature occurs at site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, and response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner & Architect in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule with a pencil copy of pay application.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and interested parties identified by Contractor with a need to know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Preconstruction photographs.
   2. Periodic construction photographs.
   3. Final completion construction photographs.

1.3 SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph or video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.
   1. Digital Camera: Minimum sensor resolution of 8 megapixels.
   2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
   3. Identification: Provide the following information with each image description in file metadata tag:
      a. Name of Project.
      b. Name and contact information for photographer.
      c. Name of Architect.
      d. Name of Contractor.
      e. Date photograph was taken.
      f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
      g. Unique sequential identifier keyed to accompanying key plan.

C. Construction Photographs: Submit two prints of each photographic view within seven days of taking photographs.
   1. Format: 8 inch by 10 inch (203 mm by 254 mm) smooth surface matte prints on single weight, commercial grade photographic paper; mounted on card stock to allow a 1 inch (25 mm) wide margin punched for standard three-ring binder.
   2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:
      a. Name of Project.
      b. Name and contact information for photographer.
      c. Name of Architect.
      d. Name of Contractor.
      e. Date photograph was taken if not date stamped by camera.
      f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
      g. Unique sequential identifier keyed to accompanying key plan.

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.5 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
   1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image editing software.
   1. Date and Time: Include date and time in file name for each image.
   2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.

C. Preconstruction Photographs: Before commencement of the Work, take photographs of site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
   1. Flag construction limits before taking construction photographs.
   2. Take minimum of 20 photographs to show existing conditions adjacent to property before starting the Work.
   3. Take minimum of 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
   4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Photographs: Take minimum of 20 photographs monthly, coinciding with cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
   1. Take photographs as evidence of existing project conditions as follows:
      a. Site: Take four (4) site aerial photographs at project corners.
      b. Interior views: Take four (4) minimum interior photographs of each space under construction from differing directions or as required.
      c. Exterior views: Take two (2) photographs of each elevation.
      d. Details: Take as required to document concealed conditions, including, but not limited to, underground construction, utility penetrations and installation, steel erection, concrete and masonry reinforcing, waterproofing and flashing, and roofing installation.

E. Architect Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

F. Time Lapse Sequence Construction Photographs: Take minimum of 20 photographs as indicated, to show status of construction and progress since last photographs were taken.
   1. Frequency: Take photographs monthly, coinciding with the cutoff date associated with each Application for Payment.
   2. Vantage Points: Following suggestions by Architect and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time to create a time lapse sequence.
      a. Commencement of the Work, through completion of subgrade construction.
      b. Above grade structural framing.
      c. Exterior building enclosure.
      d. Interior Work, through date of Substantial Completion.

G. Final Completion Construction Photographs: Take minimum of 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
   1. Do not include date stamp.

H. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
   1. Three days' notice will be given, where feasible.
   2. In emergency situations, take additional photographs within 24 hours of request.
   3. Circumstances that could require additional photographs include, but are not limited to, the following:
      a. Special events planned at Project site.
      b. Immediate follow up when on site events result in construction damage or losses.
      c. Take photographs at fabrication locations away from site.
      d. Substantial Completion of a major phase or component of the Work.
      e. Extra record photographs at time of final acceptance.
      f. Owner's request for special publicity photographs.

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

A. Submittals: Written and graphic information and physical samples that require Architect's responsive action or are for information and do not require the architect’s action.

B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

C. Portable Document Format (PDF): An open standard file format used for representing documents in a device independent and display resolution independent fixed layout document format.

1.4 SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal: Submit concurrently with construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
   1. Upon request, Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
      a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
      b. Digital Drawing Software Program: The Contract Drawings are available in Revit.
      c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
      d. The following digital data files will by furnished for each appropriate discipline:

1) Floor plans.
2) Reflected ceiling plans.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
   a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow ten (10) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process in same manner as initial submittal.
3. Resubmittal Review: Allow ten (10) days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow ten (10) days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
3. Transmittal Form for Electronic Submittals: Use software generated form from electronic project management software acceptable to Owner**,** containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.

n. Related physical samples submitted directly.
o. Indication of full or partial submittal.
p. Transmittal number, numbered consecutively.
q. Submittal and transmittal distribution record.
r. Other necessary identification.
s. Remarks.

4. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Submit electronic submittals via email as PDF electronic files.
   a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

   OR
2. Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.

3. Certificates and Certifications Submittals: Provide statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
   b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's catalog cuts.
      b. Manufacturer's product specifications.
      c. Standard color charts.
      d. Statement of compliance with specified referenced standards.
      e. Testing by recognized testing agency.
      f. Application of testing agency labels and seals.
      g. Notation of coordination requirements.
      h. Availability and delivery time information.

   4. For equipment, include the following in addition to the above, as applicable:
      a. Wiring diagrams showing factory installed wiring.
      b. Printed performance curves.
      c. Operational range diagrams.
      d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

   5. Submit Product Data before or concurrent with Samples.
   6. Submit Product Data in PDF electronic file.

C. Shop Drawings: Prepare Project specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
      e. Notation of dimensions established by field measurement.
      f. Relationship and attachment to adjoining construction clearly indicated.
      g. Seal and signature of professional engineer if specified.

   2. Sheet Size: Except for templates, patterns, and similar full size drawings, submit Shop Drawings on sheet size indicated in specification section.

   3. Submit Shop Drawings in PDF electronic file.
   4. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
      a. Prepare Shop Drawings in same digital data software program, version, and operating system as the original Drawings.
      b. Refer to Section 01 31 00 for requirements for coordination drawings.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
   1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
   2. Identification: Attach label on unexposed side of Samples that includes the following:
      a. Generic description of Sample.
      b. Product name and name of manufacturer.
      c. Sample source.

d. Number and title of applicable Specification Section.
e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples: Submit full size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Key Items Review Time: Submit samples to the Architect at least 30 days prior to the date the Contractor needs the reviewed submittals returned. The Contractor shall be prepared to submit color samples on any key items in Division 09 finishes within 30 days of the award of Contract. Once samples of all key items are received, the Architect will finalize color selections.
   b. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.
   5. Submit product schedule in PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Division 01.

G. Contractor's Construction Schedule: Comply with requirements specified in Division 01.

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00.

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00.

J. Closeout Submittals required for Substantial Completion: Comply with requirements specified in Section 01 77 00.

K. Maintenance Data: Comply with requirements specified in Section 01 78 23.

L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
   1. Name of evaluation organization.
   2. Date of evaluation.
   3. Time period when report is in effect.
   4. Product and manufacturers' names.
   5. Description of product.
   6. Test procedures and results.
   7. Limitations of use.

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM File Incorporation: Incorporate delegated design drawing and data files into Building Information Model established for Project.
   1. Prepare delegated design drawings in the same digital data software program, version, and operating system as the original Drawings.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

C. Incomplete submittals are not permitted, will be considered nonresponsive, and will be returned for resubmittal without review.

D. Submittals not required by the Contract Documents will be returned by the Architect without action.

END OF SECTION 01 33 00

SECTION 01 35 16 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Special procedures for alteration Work.

1.3 DEFINITIONS

A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed completely within existing spaces or on existing surfaces as part of the Project.

B. Consolidate: To strengthen loose or deteriorated materials in place.

C. Design Reference Sample: A sample that represents the Architect's prebid selection of Work to be matched; it may be existing Work or Work specially produced for the Project.

D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

K. Retain: To keep existing items that are not to be removed or dismantled.

L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.4 COORDINATION

A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration Work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration Work.
   1. Schedule construction operations in sequence required to obtain best Work results.
   2. Coordinate sequence of alteration Work activities to accommodate the following:
      a. Owner's continuing occupancy of portions of existing building.

b. Owner's partial occupancy of completed Work.
c. Other known Work in progress.
d. Tests and inspections.
e. GPISD Testing Calendar for State Starr and TAAS Testing

3. Detail sequence of alteration Work, with start and end dates.
4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
5. Use of elevator and stairs.
6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
7. Daily cleaning when teachers and students are present in the facility.

B. Pedestrian and Vehicular Circulation: Coordinate alteration Work with circulation patterns within Project building(s) and site. Some Work is near circulation patterns and adjacent to restricted areas. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of Work. Access to restricted areas may not be obstructed. Plan and execute the Work accordingly.

1.5 PROJECT MEETINGS FOR ALTERATION WORK

A. Preliminary Conference for Alteration Work: Before commencing alteration Work, conduct conference at site.

B. Coordination Meetings: Conduct coordination meetings specifically for alteration Work at regular intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Review items of significance that affect progress of alteration Work.
a. Interface requirements of alteration work with other Project Work.
b. Status of submittals for alteration Work.
c. Access to alteration work locations.
d. Effectiveness of fire prevention plan.
e. Quality and work standards of alteration Work.
f. Change Orders for alteration Work.

2. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.
1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to Owner where directed.

B. Alteration Work Subschedule: Submit alteration Work subschedule within seven days of date established for commencement of alteration Work.

C. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration Work operations.

D. Alteration Work Program: Submit 30 days before Work begins.

E. Fire Prevention Plan: Submit 30 days before Work begins.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with the IBC and the IEBC for alteration Work.
   2. Fire Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire control devices during each phase or process. Coordinate plan with Owner's fire protection equipment and requirements. Include fire watch personnel's training, duties, and authority to enforce fire safety.
   3. Safety and Health Standard: Comply with ANSI/ASSE A10.6.
   4. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a *Lead-Safe Certified Firm* according to 40 CFR 745, Subpart E, and use only workers that are trained in lead safe Work practices.
   5. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS).
      d. Coordinate with Local Jurisdictions on their requirements.

B. Specialist Qualifications: An experienced firm having minimum 10 years documented experience that is regularly engaged in specialty Work similar in nature, materials, design, and extent to alteration Work specified.
   1. Field Supervisor Qualifications: Full time supervisors experienced in specialty Work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on site when specialty Work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
      a. Construct new mockups of required Work whenever a supervisor is replaced.

C. Alteration Work Program: Prepare a written plan for alteration Work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole Project alteration Work program with specific requirements of programs required in other alteration Work Sections.
   1. Dust and Noise Control: Include locations of proposed temporary dust and noise control partitions and means of egress from occupied areas coordinated with continuing on site operations and other known Work in progress.
   2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

1.8 STORAGE AND HANDLING OF SALVAGED MATERIALS

A. Salvaged Materials:
   1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
   2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

B. Salvaged Materials for Reinstallation:
   1. Repair and clean items for reuse as indicated.

2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction Work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction Work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.

D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
2. Secure stored materials to protect from theft.
3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 degrees F (3 degrees C) or more above the dew point.

E. Storage Space:
1. Owner will arrange for limited on site location(s) for free storage of salvaged material. Storage space does not include security and climate control for stored material.

2. Arrange for offsite locations for storage, protection, and insurance coverage of salvaged material that cannot be stored and protected on site.

1.9 FIELD CONDITIONS

A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of measured drawings, preconstruction photographs, and preconstruction videotapes.
1. Comply with requirements specified in Section 01 32 30.
2. All Low Voltage Devices must be tested and documented prior to construction.

B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling Work.

C. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration Work.
1. Use proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration Work is being performed.
3. Erect temporary barriers to form and maintain fire egress routes.

4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration Work.
5. Contain dust and debris generated by alteration Work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
8. Provide supplemental sound control treatment to isolate demolition Work from other areas of the building.

B. Temporary Protection of Materials to Remain:
1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:
1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration Work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration Work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

E. Existing Drains: Prior to the start of Work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin Work in an area until the drainage system is functioning properly.
1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration Work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

F. Existing Roofing: Prior to the start of Work in an area, install roofing protection.

G. Fire watch must present for all torching operations.

3.2 PROTECTION FROM FIRE

A. Follow fire prevention plan and the following:
1. Comply with NFPA 241 requirements unless otherwise indicated.
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate Work.
   a. If combustible material cannot be removed, provide fire blankets to cover materials.

B. Heat Generating Equipment and Combustible Materials: Comply with procedures while performing Work with heat generating equipment or combustible materials, including welding, torch cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of open flame or welding or other high heat equipment. Use of open flame equipment is permitted. Notify Owner at least 72 hoursbefore each occurrence, indicating location of such Work.
2. As far as practicable, restrict heat generating equipment to shop areas or outside the building.
3. Do not perform Work with heat generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before Working with heat generating equipment or combustible materials, station personnel to serve as a fire watch at each location where Work is performed. Firewatch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
    a. Train each fire watch in the proper operation of fire control equipment and alarms.
    b. Prohibit firewatch personnel from other Work that would be a distraction from firewatch duties.
    c. Cease Work with heat generating equipment whenever fire watch personnel are not present.
    d. Have fire watch personnel perform final fire safety inspection each day beginning no sooner than 30 minutes after conclusion of Work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
    e. Maintain fire watch personnel at each area of site until 60 minutes two hours after conclusion of daily Work.

C. Fire Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each Work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
    1. Remove temporary guards at the end of Work shifts, whenever operations are paused, and when nearby Work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.

B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration Work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.

D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.

E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 ALTERATION WORK

A. Have specialty Work performed only by qualified specialists.

B. Ensure that supervisory personnel are present when Work begins and during its progress.

C. Record existing Work before each procedure (preconstruction), and record progress during the Work. Use digital preconstruction documentation photographs or video recordings. Comply with requirements in Section 01 32 33.

D. Perform surveys of site as the Work progresses to detect hazards resulting from alterations.

E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
   1. Do not proceed with the Work in question until directed by Architect.

END OF SECTION 01 35 16

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
   3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
   4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

A. Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
   1. Laboratory Mockups: Full size physical assemblies constructed at testing facility to verify performance characteristics.
   2. Integrated Exterior Mockups: Mockups of exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
   3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality Control Testing: Tests and inspections performed on site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operations, including installation, erection, application, and similar operations.
   1. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, *experienced* means having successfully completed a minimum of five years documented experience with projects similar in nature, size, and extent; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

A. Shop Drawings: Submit plans, sections, and elevations, indicating materials and size of mockup construction.
   1. Indicate manufacturer and model number of individual components.
   2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting Work on the following systems:
   1. Seismic force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by Architect.
   2. Main wind force resisting system or wind resisting component listed in the wind force resisting system quality assurance plan prepared by Architect.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.

4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality control service.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

E. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.7 QUALITY ASSURANCE

A. Qualifications establish the minimum qualification levels required; refer to individual Specification Sections for additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated and sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated and with record of successful in service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling Work similar in material, design, and extent to that indicated for this Project, whose Work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products.

I. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor responsibilities include the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. Build site assembled test assemblies and mockups using installers who will perform same tasks for Project.
      e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
      f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit certified written report of each test, inspection, and similar quality assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect a minimum of seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting Work, fabrication, or construction. Allow **seven** days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Mockup of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies shall be constructed. Mockup, if not specifically shown on the drawings, shall be minimum 8’x8’. Mockup shall include all major façade elements and at least one window minimum 2’x2’ in size. Prior to constructing mockup verify requirements with architect. Pre-installation conferences for trades involved in Integrated Exterior Mockup shall be held after mock up is completed.

M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

N. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.8 QUALITY CONTROL

A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.

5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300.

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner:

B. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections.
   1. Verifying that manufacturer maintains detailed fabrication and quality control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
   2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
   3. Submitting a certified written report of each test, inspection, and similar quality control service to Architect with copy to Contractor and to authorities having jurisdiction.
   4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
   5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
   6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Architect.
   4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00.

B. Protect construction exposed by or for quality control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK REQUIREMENTS

A. General: This Section specifies procedural and administrative requirements for compliance with governing regulations and codes and standards imposed upon the Work. These requirements include the obtaining of permits, licenses, inspections, releases, and similar statements, as well as payments, associated with regulations, codes, and standards.

B. “Regulations” is defined to include laws, statutes, ordinances, and lawful orders issued by governing authorities, as well as those rules, conventions and agreements within the construction industry which effectively control the performance of the Work regardless of whether they are lawfully imposed by governing authority or not.

C. Governing Regulations: Refer to General and Supplementary Conditions for requirements related to compliance with governing regulations.

1.3 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized", "selected", "required", and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown", "noted", "scheduled", and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

J. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Individual Specification Sections indicate which codes and standards the Contractor must keep available at the project site for reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Conflicting Requirements: Where compliance with two or more standards is specified, and where these standards establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents specifically indicate a less stringent requirement. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect/Engineer for a decision before proceeding.

D. Minimum Quantities or Quality Levels: In every instance the quantity or quality level shown or specified is intended to be the minimum for the Work to be provided or performed. Unless otherwise indicated, the actual Work may either comply exactly, within specified tolerances, with the minimum quantity or quality specified, or may exceed that minimum within reasonable limits. In complying with these requirements, the indicated numeric values are either minimum or maximum values, as noted, or as appropriate for context of the requirements. Refer instances of uncertainty to the Architect/Engineer for decision before proceeding.

1.5 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the trade association, standards-producing organization, authorities having jurisdiction or other entity applicable to the context of the text provision.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the Agency.

C. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations.

1.6 SUBMITTALS

A. Permits, Licenses and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 42 00

SECTION 01 45 23 – STRUCTURAL TESTING AND INSPECTION SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. The testing laboratory shall make all inspections and perform all tests in accordance with the building code, local authorities, ASTM specifications and the Contract Documents.

B. The testing laboratory shall provide as a part of the project's close-out documents or as required by any regulatory authority, all appropriate signed and sealed Special Inspection Certificates whose purpose would be to provide consistency and direction for compliance with the referenced Building Code. These Special Inspection Certificates shall confirm that that all work requiring special inspection has been adequately performed, and the special inspections have been made by an individual or firm that is qualified to make special inspections per the referenced Building Code.

C. Materials and workmanship not meeting the required standards are to be removed and replaced. Replacement and subsequent testing shall be at the expense of the Contractor.

D. Testing, inspection, and certifications specified in other sections of these Specifications shall be paid by the Owner, unless otherwise indicated.

E. Inspection by the laboratory shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.

1.3 REFERENCED STANDARDS

A. The latest adopted edition of all standards referenced in this Section shall apply, unless noted otherwise.

B. ACI 311 – ACI Manual of Concrete Inspection

C. ACI 301 - Specification for Structural Concrete

D. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY ASSURANCE

A. Testing Laboratory shall meet the requirements of ASTM E329 and ASTM E543.

B. Testing Laboratory shall be insured against errors and omissions by a professional liability insurance policy having a limit of liability not less than $500,000.

C. Testing Laboratory shall be under the direction of a Registered Engineer who is legally authorized to practice in the jurisdiction where Project is located and having at least five years experience in inspection and testing of construction materials.

D. Laboratory staff monitoring concrete work shall be ACI certified inspectors.

E. Laboratory staff performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors". The inspector may be supported by assistant inspectors who may perform specific inspection functions under the supervision of the inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). The work of the assistant inspectors shall be regularly monitored by the inspector, generally on a daily basis.

F. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.5 LABORATORY RESPONSIBILITIES

A. Attend preconstruction meetings and progress meetings as required to coordinate work with the Contractor and address quality control issues.

B. Test samples of design mixes submitted by Contractor.

C. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.

D. Perform specified inspecting, sampling, and testing of Products in accordance with specified standards.

E. Ascertain compliance of materials and mixes with requirements of Contract Documents.

F. Promptly notify Architect/Engineer and Contractor of observed irregularities or non conformance of Work or Materials.

G. Perform all inspections and tests in accordance with building code requirements for "Special Inspection" whether or not such inspections are specified in the Contract Documents.

H. Testing Laboratory shall write a letter at the completion of the project, signed, and sealed by a registered engineer in the state of the project, summarizing the inspections performed, the dates they were performed, and whether the observed construction complied with the Contract Documents.

1.6 LABORATORY REPORTS

A. After each inspection and test, promptly submit copies of laboratory reports to Architect, Engineer, Owner and to Contractor.

B. Include:

1. Date issued
2. Project title and number
3. Name of inspector
4. Date and time of sampling or inspection
5. Identification of product and specifications section
6. Location in the Project
7. Type of inspection or test
8. Date of test
9. Results of tests
10. Conformance with Contract Documents

1.7 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge the requirements of the Contract Documents.

B. Laboratory may not approve or accept any portion of the Work, except where such approval is specifically called for in these specifications.

C. Laboratory may not assume any duties of Contractor.

D. Laboratory has no authority to stop the Work.

1.8 CONTRACTOR RESPONSIBILITIES

A. See technical sections of these specifications for specific requirements.

B. Deliver to the laboratory, without cost to the Owner, adequate samples of materials proposed for use which are required to be tested.

C. Advise laboratory sufficiently in advance of construction operations to allow laboratory to complete any required checks or tests and to assign personnel for field inspection and testing as specified.

D. Provide facilities for safe storage and proper curing of concrete test samples on project site for the first 24 hours and also for subsequent field curing as required by ASTM specifications C31.

E. Provide incidental labor and equipment as required to assist laboratory personnel in obtaining and handling samples at the site and in accessing work for inspection.

F. Furnish concrete mix designs, in accordance with ACI 301, section 3.9, made by an independent testing laboratory or qualified concrete supplier. Where mix designs are required, the laboratory shall be selected and paid by the Contractor.

G. Provide current welder certifications for each welder to be employed.

H. Furnish fabrication and erection inspection of all welds in accordance with AWS D1.1, Chapter 6.

I. Prequalification of all welding procedures to be used in executing the work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PIER DRILLING

A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.

B. The laboratory representative shall make continuous inspections to determine that the proper bearing stratum is obtained and that shafts are clean and dry before placing concrete.

C. The laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, whether or not casing is required, bell size (if required), actual penetration into bearing stratum, and elevation of top of bearing stratum.

3.2 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

A. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with the Contract Documents and approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor for correction. If uncorrected by the Contractor, they shall be listed in the report.

B. Observe and report on the following:

1. Number and size of bars
2. Bending and lengths of bars
3. Splicing
4. Clearance to forms including chair heights
5. Clearance between bars or spacing
6. Rust, form oil, and other contamination
7. Grade of Steel
8. Securing, tying and chairing of bars
9. Excessive congestion of reinforcing steel
10. Installation of anchor bolts and placement of concrete around anchor bolts
11. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
12. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents

C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years experience inspecting reinforcing steel in projects of similar size.

3.3 REINFORCING STEEL MECHANICAL SPLICES

A. Each mechanical splice shall be visually inspected to ensure compliance with the ICBO Reports and the manufacturer's published criteria for acceptable completed splices.

B. Special emphasis shall be placed on inspection of the end preparation of each bar to be spliced, as required by the ICBO report.

C. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and whether splice is accepted or rejected. Reasons for rejection shall be shown on each report.

3.4 CONCRETE INSPECTION AND TESTING

A. Secure composite samples of concrete at the jobsite in accordance with ASTM C172.

B. Mold and cure specimens from each sample in accordance with ASTM C31. The test cylinders shall be stored in the field 24 hours and then carefully transported to the laboratory and cured in accordance with ASTM C31.

C. Test specimens in accordance with ASTM C39. Two specimens shall be tested 7 days, two specimens shall be tested at 28 days for strength acceptance. A spare cylinder shall be made and kept for a 56-day break if the 28-day break does not meet strength requirements. If the plans require 56-day break (such as for mass concrete), two samples shall be tested at 56 days for acceptance.

D. Make one strength test (four or five cylinders) for each:

1. 100 cubic yards or fraction thereof, of each mix design placed in one day.
2. OR, for each 5000 sq. ft. of slab area placed in one day.
3. When the total quantity of a given class of concrete is less than 25 cu. yds., the strength tests may be waived by the Architect/Engineer, if in his judgment, adequate evidence of satisfactory strength is provided.

E. Make one slump test for each set of cylinders following the procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever the consistency of the concrete appears to vary. Do not permit placement of concrete having measured slump outside the limits given on the drawings, except when approved by the Architect. Slump tests corresponding to samples from which strength tests are made shall be reported with the strength test results. Other slump tests need not be reported.

F. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.

G. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.

H. Determine temperature of concrete sample for each strength test and one test for each concrete load discharged when air temperature is 80 degrees F. and above.

I. Monitor the addition of water at the jobsite and the length of time the concrete is allowed to remain in the truck before placement. Report any significant deviation from the approved mix design and the project requirements to the Architect, the Contractor, and the Concrete Supplier.

J. Monitor the slump and air content of the concrete. If the measured slump or air content of air entrained concrete falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the project requirements and specifications and shall be rejected.

K. The testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and the time at which the cement and aggregate was dispensed into the truck, and the time at which concrete was discharged from the truck.

L. Laboratory reports shall contain the following information:

1. Class of concrete and specific location.
2. Specified strength of concrete.
3. Air temperature.
4. Batch time.
5. Specified time that discharge of concrete must be completed, based on air temperature.
6. Time concrete is placed.
7. Amount of water withheld at the plant for latter addition at the project site (Note that the total amount of water shall not exceed the maximum water/cement ratio for the approved mix design).
8. Amount of water added at the site.
9. Allowable slump range on the approved mix design.
10. Slump.
11. Maximum and minimum allowable concrete temperature on the approved mix design.
12. Temperature of the concrete mix.
13. Air content range on the approved mix design.
14. Air content.
15. Statement that concrete is in compliance with the project documents and the approved mix designs.

M. Evaluation and Acceptance:

1. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results are equal to or exceed the specified strength and no individual test result (average of two cylinders) is below the specified strength by more than 500 psi.
2. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Buildings," ACI 301 have been met.

N. Observe the placing of all concrete, except site work. Observe and report on placing method, consolidation, cold joints, length of drop and displacement of reinforcing. Report deficiencies to the Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.

O. Comply with ACI 311, "Guide For Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).

P. Inspect the application of curing compound and monitor all curing conditions to assure compliance with Specification requirements. Report curing deficiencies to the Contractor immediately and submit a report to the Architect.

3.5 MASONRY

A. Inspection

1. Provide a qualified inspector to inspect all structural masonry work.
   a. Inspect masonry for compliance in accordance with the “Level 1 or 2 Special Inspection” provisions of the building code. Refer to the contract documents regarding which level of special inspections is required.
2. In combination with inspections required by the building code, inspect the following:
   a. Preparation of masonry prisms for testing.
   b. Placement of reinforcing.
   c. Cavities to be grouted (prior to grouting and prior to closing cleanouts).
   d. Mortar mixing operations, including proportion of materials and method of measuring materials (materials should be measured with a mixing box and not a shovel).
   e. Bedding of mortar for each type of unit and placing of units.
   f. Grouting operations.
   g. Condition of units before laying for excessive absorption.
3. Provide report of each inspection.

B. Field Compressive Tests for Grout:

1. Secure composite samples of grout at the jobsite in accordance with ASTM C 1019.
2. Mold and cure three specimens from each sample in accordance with ASTM C 1019. Supervise the curing protection provided (by others) for test specimens in the field and the transportation from the field to the laboratory. The test specimens shall be stored in the field 24 to 48 hours and then be carefully transported to the laboratory and cured in accordance with ASTM C 1019.
3. Test specimens in accordance with ASTM C 1019. Two specimens shall be tested at 28 days for acceptance and one specimen shall be tested at 7 days for information.
4. Make one strength test (three specimens) for each 10 cubic yards of grout poured but not less than one strength test for each 5000 square feet of wall area.

C. Prism Tests:

1. Build prisms at the jobsite using the same materials and methods as being used for the wall construction. Store prisms in a place where they will be undisturbed for two days and have approximately same curing conditions as masonry construction. After 48 hours, move prisms to the laboratory and test in accordance with ASTM C1314.
2. Make prism tests in advance of operations using materials under same conditions, with the same bonding and construction methods as is being used for the structure. When building prisms, moisture content of the units at time of laying, consistency of mortar and width and thickness of mortar joints shall be same as used in the structure.
3. Build prisms of hollow masonry units the same width as unit by 16" long by 16" high. Apply mortar to face shells only. Do not fill hollow core with grout. Compute value of ultimate net compressive strength, by dividing ultimate load by net face shell area of masonry units.
4. Cure and test prisms in accordance with applicable provisions of ASTM C1314. Test five specimens of each type of masonry unit before delivering material to the jobsite and submit results for approval. During construction, test three specimens of each type of masonry unit for each 5000 square feet of wall placed.
5. The prisms shall be tested after 28 days but may be tested at seven days provided the relationship between seven and 28 day strengths has been established for the materials used prior to the start of construction.

6. When the average strength of a set of prisms falls below the specified compressive strength (f'm), the masonry corresponding to the test shall be deemed unacceptable. In such a case, notify the Architect and Contractor immediately.

3.6 STRUCTURAL STEEL

A. Inspect all structural steel during and after erection for conformance with Contract Documents and shop drawings.

B. Field Inspection

1. Proper erection of all pieces.
2. Proper installation of all bolts, including the checking of calibration of impact wrenches used with high strength bolts.
3. Plumbness of structure and proper bracing.
4. Field Painting.
5. Visual examination of all field welding.
6. Ultrasonic testing of all penetration welds.
7. Installation of field welded shear studs.
8. Measure and record camber of all beams upon arrival and before erection for compliance with the specified camber. Measure lying flat with web in horizontal position. Members outside specified camber tolerance shall be returned to the shop for remedial work.

C. Qualification of Welders: Fabricator and erector shall provide the testing laboratory with names of welders to be employed in the work, together with certification that welders have passed qualification tests within the last year using procedures specified in the AWS D1.1. Testing laboratory shall verify all welder's qualifications.

D. Inspection of shop and field welding shall be "verification inspection," in accordance with Section 6 of AWS D1.1 and as follows:

1. Visually inspect the welding of all shop fabricated members and note the location of all cover plates, connectors, bearing stiffeners, splices, and fillet welds for proper return around ends and check for seams, folds, and delamination.
2. Ultrasonically test all penetration welds in accordance with AWS D1.1.
3. Inspect surfaces to be welded. Surface preparations, fit-up and cleanliness of surface shall be noted.
4. The welding inspector shall be present during alignment and fit-up of members being welded and shall check for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, the inspector shall order the joint to be chipped down to sound metal or gouged out and rewelded. Root passes shall be thoroughly inspected for cracks. All cracks shall be gouged out and rewelded to two inches beyond each end of crack.
5. The inspector shall check that all welds have been marked with the welder’s symbol. The inspector shall mark the welds requiring repairs and shall make a reinspection. The inspector shall maintain a written record of all welds. Work completed and inspected shall receive an identification mark by the inspector.
6. The testing laboratory shall advise the Owner and the Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination by means other

than those specified. Such further tests and examinations shall be performed as authorized by the Owner and the Architect.

7. The Owner reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.

E. Inspection of bolted construction shall be in accordance with AISC "Specification for Structural Steel Buildings" and as follows:

1. All bolts shall be visually inspected to ensure that the plies have been brought into snug contact.
2. High strength bolting shall be inspected in accordance with Section 9 of the AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
3. For all high strength bolts, unless specifically noted on the Drawings to require only "snug-tight" installation, the inspector shall observe the required jobsite testing and calibration and shall confirm that the procedure to be used provides the required tension.
4. For slip critical connections, inspect the contact surfaces for compliance with specifications prior to bolting.

F. Inspection of stud welding shall be in accordance with Section 7.8 of AWS D1.1 and as follows:

1. A minimum of two shear studs shall be welded at the start of each day’s production period in order to determine proper generator, control unit and stud welding setting. These studs shall be capable of being bent at 45 degrees from vertical without weld failure.
2. When the temperature is below 32 degrees Fahrenheit, one stud in each 100 shall be tested after cooling. Studs shall not be welded below zero degrees Fahrenheit or when the surface is wet due to rain, snow, or ice. If a stud fails, two new studs shall pass the test before resumption of the welding.
3. Visually inspect studs for compliance with the Contract Documents. Check number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360-degree fillet has not been obtained for a particular stud, such stud shall be struck with a hammer and bent 15 degrees off perpendicular. Studs failing this test shall be replaced.

3.7 OPEN WEB JOISTS AND JOIST GIRDERS

A. Inspect all joists either in the plant or at the jobsite for conformance with specified fabrication requirements. Check welded connections between web and chord, splices, and straightness of members. Inspection at the plant may be performed by the manufacturer’s qualified QC personnel.

B. Inspect installation of joists at the jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for conformance with the Contract Documents and referenced standards.

C. Check welder qualification certificates for field welding operators.

3.8 STEEL FLOOR DECK

A. Field Inspection shall consist of the following:

1. Check types, gauges, and finishes for conformance with the Contract Documents and shop drawings.
2. Examination of proper erection of all metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
3. Certification of welders.
4. Field welded shear studs used to fasten metal floor decking to supporting steel shall be inspected and tested as described in the structural steel section of this specification section.

3.9 STEEL ROOF DECK

A. Field inspection shall consist of the following:

1. Checking types, gauges, and finishes for conformance with the Contract Documents and Shop Drawings.
2. Examination for proper erection of all metal deck, including fastenings at supports and sidelaps, reinforcing of holes, and miscellaneous deck supports.
3. Certification of welders.
4. Visual inspection of at least 20 percent of all welds.

3.10 SPRAYED FIREPROOFING

A. Verify that applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.

B. Verify that installation meets fire rating requirements of approved design.

C. Inspect and test for thickness as follows:

1. Test 20 percent of structural frame columns and beams in each building level.
2. Test 10 percent of beams other than structural frame in each building level.
3. Test one slab per each 5000 square feet of building area.

D. Inspect and test for density on slabs, beams, and columns. Perform one of each test for each 10,000 square feet of building area.

E. Inspect and test for bond strength, one test for beams and one test for slabs for each 10,000 square feet or area.

F. Inspection and test procedures shall be performed in accordance with ASTM E605 and E736.

3.11 EXPANSION BOLT INSTALLATION

A. Inspect the drilling of each hole and installation of each expansion bolt for compliance with the Contract Documents.

B. Verify the installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.12 TESTING OF NON-SHRINK GROUT

A. Make one strength test for every 15 base plates grouted and for every 15 bags of grout used in joints between members.

B. Each test shall consist of four cubes, two to be tested at seven days, and two at 28 days, made and tested in accordance with ASTM C109, with the exception that the grout shall be restrained from expansion by a top plate.

3.13 EXCAVATION

A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.

B. Review geotechnical parameters and assumptions used in the development of calculations and drawings for retention systems, including lateral design forces, rock wedge stability analysis, rock bolt lengths and spacing, and surcharge effects.

C. Observe the excavation process, the exposed faces of the excavation and the installation of retention systems. Check for compliance with the Contract Documents and make alternative recommendations as may be required to suit field conditions.

D. Review required submittals as they pertain to geotechnical requirements.

E. Check the adequacy and accuracy of the Contractor's monitoring program, equipment, procedures, and measurements related to movements of the excavated face and adjacent structures.

F. Immediately report any observed unsafe conditions. Request additional shoring, bracing, or rock bolting where judged to be necessary as the excavation progresses.

3.14 WATER PRESSURE INJECTION OR LIME SLURRY PRESSURE INJECTION

A. The representative of the Owner's Geotechnical Engineer shall make continuous observations throughout the injection operations as per the geotechnical report.

B. The representative of the Owner's Geotechnical Engineer may propose to perform additional tests if required to properly evaluate the injected soil. The representative of the Owner's Geotechnical Engineer shall evaluate the results of the tests to determine the acceptability of the injected areas and to determine if additional injections are required.

3.15 FILLING AND BACKFILLING

A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.

B. The Contractor shall make available to the laboratory, adequate samples of each fill and backfill material from the proposed sources of supply not less than 10 days prior to the start of the work.

C. Laboratory shall analyze samples as required to provide a soil description and to determine compliance with quality requirements. Perform the following tests:

1. Test for liquid limit in accordance with ASTM D423.
2. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
3. Tests for moisture density relations of soil in accordance with ASTM D698 or D1557, as applicable.

D. Furnish a report for each individual test and state whether sample conforms to specified requirements or reasons for nonconformance.

E. Inspect under slab drainage material and placement for compliance with specified gradation, quality, and compaction.

F. Make in-place compaction test for moisture content, moisture-density relationship, and density of fill material after compaction to determine that backfill materials have been compacted to the specified density. Number of tests shall be as follows:

1. One test for each 5000 square feet of area of each lift placed under floor slab. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
2. One test for each 150 linear feet, or portion thereof, of each lift placed against foundation walls, with locations staggered from those in the previous lift.
3. One test of each lift placed below any isolated footing, and every 100 linear feet under continuous footings, with locations taken on a different side from that in the lift below.

3.16 TILT-UP PANELS

A. Concrete Reinforcing Steel and Embedded Metal Assemblies: Inspect in accordance with the Concrete Reinforcing Steel and Embedded Metal Assemblies section of this Specification.

B. Concrete Inspection and Testing: Perform in accordance with the Concrete and Inspection and Testing section of this specification.

C. Inspection of Tilt-up concrete during erection:

1. Inspect members for cracks, spalls, and other deficiencies after erection.
2. Inspect erection of tilt-up members for placement tolerances, and to ensure that connections, bearing lengths, welding and grouting conform to the Contract Documents.

3.17 POST-TENSIONING

A. Verify certification of calibration of jacking equipment used in post-tensioning operations.

B. Observe and report on placement and anchorage of tendons immediately prior to concreting.

C. Provide a qualified, experienced inspector to observe the stressing and elongation measurement of each tendon. Inspector shall have a minimum of five years' experience inspecting post-tensioning operations.

D. The Contractor shall log and submit detailed reports of the stressing and elongation of each tendon. The laboratory representative shall observe the recording of information by the Contractor and make such spot checks as necessary to verify the accuracy of the post tensioning reports.

E. Receive and review final stressing and elongation reports prepared by the contractor. Compare the actual and required elongation of each tendon and the actual and required load on each tendon. Grant permission to cut tails of tendons which are within the specified tolerance, unless otherwise noted on the Drawings, and submit reports of those which are not within the specified tolerance to the Architect for further evaluation.

F. Observe and report on grouting of tendons noted to be bonded.

G. Reports shall be submitted to the Architect within 48 hours after stressing.

H. The post-tensioning subcontractor shall provide a letter at the completion of the project, signed and sealed by a registered engineer in the state of the project, stating that the post-tensioning work was completed in accordance with the contract documents. The post-tensioning subcontractor shall review the stressing records and certify that the required forces shown on the contract documents have been provided.

3.18 FOOTING EXCAVATIONS

A. A representative of the Owner's Geotechnical Engineer shall inspect each footing excavation to determine that the proper bearing stratum is obtained and that excavations are properly clean and dry before the concrete is placed.

END OF SECTION 01 45 23

SECTION 01 45 23 - TESTING AND INSPECTING SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements and qualifications including but not limited to:
   1. Professional testing and laboratory services.
   2. Accessories necessary for the completion of testing and laboratory services.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
   3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
   4. Specific test and inspection requirements are not specified in this Section.

C. A qualified independent testing laboratory and/or geotechnical engineering service selected and paid by Owner.
   1. The Owner will pay for the initial laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for testing and retesting of materials that do not comply with the requirements of the Contract Documents.

D. Inspecting agency shall perform inspections and tests in accordance with the rules and regulations of the building code, local authorities, Specifications of ASTM, and the Contract Documents.

E. Materials and workmanship found not in compliance with required standards or performance obligations shall be removed and replaced. Replacement and subsequent testing shall be at Contractor’s expense.

F. Where terms “Inspector” and “Laboratory” are used, it is meant and in reference to an officially designated and accredited inspector of the testing laboratory or geotechnical service engaged by Owner.

G. Laboratory inspections shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.

H. Contractor or Fabricator shall cooperate with the testing laboratory in matters pertaining to the Work.

I. Contractor to address deficiency and failed reports.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329 and ASTM E534; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
   3. Testing agencies shall be insured against errors and omissions by a professional liability insurance policy having a minimum limit of liability of $500,000.00.

B. Inspection and testing services the of testing agency shall be under the direction of a Registered Engineer licensed in the State of Texas, charged with engineering managerial responsibility, and having a minimum of five (5) years engineering experience in inspection and testing of construction materials.

C. Concrete Inspectors: Inspecting personnel monitoring concrete Work shall be ACI certified inspectors.

D. Structural Steel: Primary inspectors performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, *Standard and Guide for Qualification and Certification of Welding Inspectors*.
   1. Inspector may be supported by assistant inspectors who perform specific inspection functions under the direct supervision of the Primary Inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). Work of assistant inspectors shall be monitored daily by the inspector.

E. Testing Equipment: Equipment shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards.

F. Referenced Standards: Latest adopted edition of standards referenced apply to the Work. In the event of conflict between the Contract Documents and referenced standards, the Contract Documents shall govern. In case of conflict between Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY CONTROL

A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
   1. Refer to the individual specification sections for specific requirements.
   2. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
   3. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

4. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
5. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
6. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
7. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
8. Associated Responsibilities and Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
    a. Provide access to the Work.
    b. Deliver of samples to testing laboratory, without cost to Owner, in adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
    c. Advise laboratory and Architect sufficiently in advance of construction operations to allow laboratory to complete required inspections or tests and to assign personnel for field inspection and testing as specified.
    d. Provide facilities for storage and curing of concrete test samples on site for the first 24 hours and for subsequent field curing required by ASTM C31.
    e. Incidental labor, facilities, and equipment necessary to assist laboratory personnel in obtaining and handling samples at the site.
    f. Preliminary design mix proposed for use for material mixes that require control by testing agency.
    g. Provide concrete mix designs in accordance with ACI 301 Section 3.9 made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, select and pay for laboratory.
    h. Obtain required inspections or approvals of the building official. Inspection requests and notifications required by building code are responsibility of the Contractor.
    i. Provide current welder certificates for each welder employed.
    j. Provide fabrication and erection inspection and testing of welds in accordance with AWS D1.1, Chapter 6.
        1) Use prequalification of welding procedures in executing the Work.

    k. Security and protection for samples and for testing and inspecting equipment at Project site.

9. Retesting/Reinspecting: Regardless of payment responsibility of the original tests or inspections, provide quality control services, including retesting and reinspecting, for construction that replaced Work failing to comply with the Contract Documents or Code requirements.

C. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

6. Do not perform any duties of Contractor.

D. Coordination: Coordinate sequence of activities to accommodate required quality assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.5 AUTHORITY AND DUTIES OF LABORATORY PERSONNEL

A. A representative of the testing laboratory, who has reviewed and is familiar with the project and specifications, shall participate in preconstruction conferences. The representative shall coordinate material testing and inspection requirements with the Contractor and its subcontractors consistent with the planned construction schedule. The laboratory representative shall attend conferences required or requested to address quality control issues.

B. Laboratory personnel shall inspect and test materials, assemblies, specimens, and Work performed, including design mixes, methods and techniques and report the progress to the Architect.

C. If material or Work fails to meet requirements of Contract Documents, laboratory inspector shall notify the Construction Manager, Architect, Engineers, supplier or subcontractor providing or preparing the materials or Work being tested of such failure.

D. Laboratory personnel shall not perform the Work of the Contractor or act as foremen or superintendents. Work will be inspected as it progresses, but failure to detect defective Work or materials shall not prevent later rejection when a defect is discovered.

E. Laboratory personnel are not authorized to revoke, alter, relax, enlarge, or release the requirements of the Contract Documents or approve or accept portions of Work, except where approval is specifically specified in the Specifications.

F. Comply with building code requirements for Special Inspections.

1.6 SUBMITTALS

A. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality control service.

C. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.

6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Submit copies of reports of each inspection and test:
   1. Owner, Program or Project Manager, Architect, and each Engineer or outside consultants regarding their particular phase of the project: One copy each.
   2. Construction Manager and Contractor: Two copies each.

E. In addition to furnishing a written report, notify Construction Manager and Contractor verbally of uncorrected conditions or failures to comply with requirements of the Contract Documents, and immediately fax and email corresponding report to the Architect and Engineer.

F. At completion of each trade or branch of Work requiring inspecting and testing, submit a final certificate attesting to satisfactory completion of Work and full compliance with requirements of Contract Documents.

G. Submit copies of test results sealed by a Registered Engineer to municipal authorities having jurisdiction, as required.

1.7 TESTING LABORATORY GUIDELINES AND PROCEDURES

A. Technicians scheduled to perform specific 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 site.

B. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for hours over eight hours spent at the site on a single day, field testing services performed on a Saturday or Sunday, and field services performed on a recognized holiday.

C. There shall be a three hour minimum for each scheduled testing service. Vehicle charges will be included on a $25.00 per trip basis.

D. Cylinder pick up will be controlled by the technician performing test on a scheduled pick up day. If there are no testing services scheduled, the cylinder pick up fee is $40.00 on week days and $50.00 on weekends and holidays with no technician or vehicle charge.

E. The Contractor shall bear the responsibility of scheduling the testing services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the testing services. Cancellations or failed test shall be reimbursable to the Owner by the responsible party for the cancellations or failure of a test or service.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Architect.
   4. Identification of testing agency or special inspector conducting test or inspection.
   5. Deficiency log.

B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 TESTING AND INSPECTION SERVICES

A. 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. The Owner reserves the right to add to or delete any or all inspection and testing specified, excluding testing required by the applicable building codes.

C. If conflicts arise between Drawings and Specifications, notify Architect immediately. The most stringent requirements shall dictate procedure.

3.3 TESTING OF EARTHWORK

A. Testing Services (As specified or required):
   1. References (As applicable for tests required):
      a. American Society for Testing and Materials (ASTM):
         1) D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3).
         2) D2922, Standard Test Method for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth).
         3) D4318, Standard Test Method for 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 in place density test for each 4,000 square feet (445 square yards) of existing subgrade material.
7. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T99 for one 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 test for each 4,000 square feet (445 square yards) of each lift of compacted fill.
9. Perform testing at a frequency of one in-place density and moisture test for each 75 lineal feet or less of utility trench, with a minimum of three tests per lift.

B. Reports: Submit reports 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 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 by telephone within one 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.

3.4 INSPECTION OF PIPED SITE UTILITIES

A. Laboratory representative shall observe and report on the following:
1. Proper alignment and grade of trenches.
2. Pipe bedding and supports.
3. Pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
4. Installation of pipe and joints.
5. Testing of piped utilities performed by Contractor.

3.5 PAVING

A. Testing Services: Perform field tests for moisture density properties:
1. Provide field testing of the subgrade as specified.
2. Paving Subbase: Provide one field test for every 7,500 square feet of area of crushed limestone or caliche subbase.
3. Lime Treated Subgrade: Provide one field test for every 7,500 square feet of area of lime treated subgrade for content of lime and subgrade compaction.
4. Cement Soil Stabilization: Provide one field test for every 7,500 square feet of area of cement stabilized subgrade for content of cement and subgrade compaction.

3.6 PIER DRILLING OPERATION

A. A representative of a qualified geotechnical laboratory shall provide services specified.

B. Laboratory representative shall make continuous inspections to determine that proper bearing stratum is obtained and utilized for bearing and that shafts are properly clean and dry before placing concrete.

C. Laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, casing required or not required, actual penetration into bearing stratum, elevation of top of bearing stratum, volume of concrete used, and deviations from specified tolerances.

D. Laboratory representative shall make continuous inspections of drilled pier construction to check the following:
1. Verify soundness of bearing stratum and desired penetration.
2. Verify pier dimensions and reinforcing used.
3. Monitor condition of hole and removal of water and loose material from bottom.
4. Monitor placement of concrete and use of tremie or pumps.
5. Monitor the extraction of casing, if used.

E. Request probe holes when deemed necessary to confirm safe bearing capacity.

3.7 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

A. Inspect concrete reinforcing steel prior to placing concrete for compliance with Contract Documents and approved shop drawings. Noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and, if left uncorrected, reported to the Architect.

B. Laboratory representative shall observe and report on the following:
1. Number and size of bars.
2. Bending and lengths of bars.
3. Splicing.
4. Clearance to forms, including chair heights.
5. Clearance to sides and bottom of trench if soil formed.
6. Clearance between bars or spacing.
7. Rust, form oil, and other contamination.
8. Grade of steel.
9. Securing, tying, and chairing of bars.
10. Excessive congestion of reinforcing steel.
11. Installation of anchor bolts and placement of concrete around such bolts.
12. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
13. 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. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years' experience inspecting reinforcing steel in projects of similar size.

3.8 CONCRETE INSPECTION AND TESTING

A. Receive and evaluate proposed concrete mix designs submitted by Contractor. If mix designs comply with Drawings and Specifications, the laboratory shall submit a letter to the Architect certifying compliance. Mix designs not complying with Drawings and Specifications shall be returned by the laboratory as being unacceptable. Check the proposed mixes for proportions, water cement ratio and slump in accordance with ACI 613 and 318.

B. Comply with ACI 311 *Guide For Concrete Inspection* and ACI *Manual of Concrete Inspection* (SP-2).

C. Sample and test concrete placed at the site in accordance with ASTM C172. Each sample shall be obtained from a different batch of concrete on a random basis.

D. Test concrete:
   1. Mold and cure five specimens from each sample.
      a. For each 50 cubic yards or fraction thereof of structural building concrete; and
      b. For each 100 cubic yards or fraction thereof of nonstructural concrete and site Work paving and sidewalks.
      c. Laboratory cure two cylinders in accordance with ASTM C192.
      d. Field cure remaining cylinders in accordance with ASTM C31.

   2. Two specimens shall be tested at seven days for information, two shall be tested at 28 days for acceptance.

E. Deviations from the requirements of ASTM Specifications shall be recorded in the test report. Test concrete specimens in accordance with ASTM C39.

F. Specimens for pumped concrete shall be taken at the discharge end of pumping equipment.

G. Supervise curing and protection provided for test specimens in field, and transportation from the field to laboratory. Test cylinders shall be stored in the field 24 hours and then carefully transported to laboratory and cured in accordance with ASTM C31.

H. Make one strength test (four cylinders) of each mix design of concrete placed in any one day.

I. Make one slump test for each set of cylinders following procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever consistency of concrete appears to vary. Slump tests corresponding to samples from which strength tests are made shall be reported with strength test results. Other slump tests need not be reported.

J. Determine total air content of air entrained normal weight concrete sample for each strength test in accordance with ASTM C231.

K. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.

L. Determine temperature of concrete sample for each strength test.

M. Inspect each batch of concrete, monitor addition of mixing water to assure uniform consistency from truck to truck. Check mixing form mixers before mix begins to set and within time limits set forth in ASTM C94.
   1. Monitor addition of water and high range water reducer to concrete at job site and length of time concrete is allowed to remain in truck during placement.

N. Testing agency shall furnish and maintain a competent inspector at the mixing plant at the start of each day's mixing. Inspector shall examine concrete materials for compliance with Specifications and approved mix design, weighing and measuring devices, proportioning and mixing of materials, water and cement content of each batch, general operation of the plant, and transportation of concrete to jobsite. Inspector shall verify that amount of free surface moisture contained in fine and course aggregate has been properly accounted for in the concrete mixing to achieve required consistency and water cement ratio.

O. Testing laboratory shall monitor addition of water to concrete at the jobsite and the length of time concrete is allowed to remain in the truck before placement. Inspector shall compare mixture with criteria on the approved mix design and report any significant deviation to the Architect, Contractor and concrete supplier. Do not permit addition of water which will exceed maximum water/cement ratio for the mix as given on the approved mix design.

P. Observe placing of concrete, except nonstructural slabs on grade and site Work. Observe and report on placing method, consolidation, cold joints, length of drop, and displacement of reinforcement. Report deficiencies to Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.

Q. Test reports shall include but no be limited to the following information: date of concrete placement, concrete mix identification number or proportion of ingredients, truck ticket number, time test was made, time of batching, location of each placement, slump, unit weight, water content (microwave test) and air content of concrete sampled and date and results of strength test.

R. Report promptly to Architect all details of reasons for rejection of any and all quantities of concrete. Give all information concerning locations of the concrete pours, quantities, date of pours, and other pertinent facts concerning concrete represented by the specimens.

S. Testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and time at which cement and aggregate were dispensed into the truck, and time at which concrete was discharged from the truck.

T. Evaluation and Acceptance:
   1. If measured slump, or air content of air entrained concrete, falls outside specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, concrete shall be considered to have failed to meet the requirements of the specifications, and shall not be used in the structure.
   2. Strength level of concrete will be considered satisfactory if the averages of sets of three consecutive strength tests results are equal to, or exceed, specified strength and no individual test result (average of two cylinders) is below specified strength by more than 500 psi.
   3. Completed concrete Work will be accepted when requirements of ACI 301 Chapter 18 *Specifications for Structural Concrete for Buildings* have been met.

U. Concrete Test Reports: Reports shall be made and distributed immediately after respective tests or inspections are made.
   1. Where reports indicate deviations from Contract Documents, they shall also include a determination of the probable cause of deviation and where applicable, a recommendation for corrective action.

V. Furnish a statistical analysis for each class of concrete placed on the project in accordance with ACI 214 and ACI 318. Information shall be updated and distributed once a month as directed by the Architect. Information shall include, but not be limited to, the following:
   1. Strength tests at 7 days of one cylinder.
   2. Strength tests at 28 days of two cylinder averages.
   3. 28 day moving average strength tests of last three test groups.
   4. Standard deviation and coefficient of variation based on 28 day strength tests.
   5. Average strength and number of 28 days tests for most recent month.

W. Test Footings (Shafts) (Piers) (Caissons): Same diameter and type specified for footings, placed in same manner. Accepted test footings may be used in the Work.

X. Noncompliant Test Reports: Fax test reports indicating noncompliance immediately to each party on the test report distribution list. Copies shall be on different colored paper.

Y. Inspect application of curing compound and monitor curing conditions to assure compliance with specification requirements. Report curing deficiencies to the Contractor immediately and submit a written report to the Architect.

3.9 TESTING OF NONSHRINK GROUT

A. Make one strength test for all plates grouted and for all grout used in joints between members.

B. Each test shall consist of four cubes, two tested at 7 days and two at 28 days, made and tested in accordance with ASTM C109, with the exception that grout shall be restrained from expansion by a top plate.

3.10 STRUCTURAL STEEL

A. Inspect structural steel during and after erection for compliance with Contract Documents and shop drawings. Review and report on fabricator's quality control procedures and capabilities.

B. Field Inspection:
1. Proper erection of pieces.
2. Proper touch up painting of shop primed structural steel exposed to view or in crawl space.
3. Proper installation of bolts.
4. Plumbness of structure and proper bracing.
5. Proper field painting.
6. Initial inspection of welding process and periodically thereafter as necessary.
7. Visual examination of completed welds.
8. Ultrasonic testing of penetration field welds.
9. Installation of field welded shear studs.
10. Inspect shop fabricated members, upon arrival at the site, for defects incurred during transit and handling.
11. Measure and record camber of beams upon arrival and before erection for compliance with specified camber. Measure lying flat with web horizontal. Return members outside specified camber tolerance to shop for correction.

C. Qualifications of Welders: Fabricator and erector shall provide the testing laboratory with names of welders employed on Work, along with certification that each welder has passed qualification tests within the past 12 months, using procedures covered in AWS D1.1 *Structural Welding Code - Steel*. Verify welder qualifications.

D. Inspection of field welding shall include:
1. Visually inspect fillet welds for size, soundness, and proper return around ends. Inspect seams, folds, and delaminations.
2. Visually inspect welds for proper repair of painting.
3. Ultrasonically test penetration welds in accordance with ASTM E164.
4. Inspect surfaces to be welded. Note surface preparations, fit up, and cleanliness of surface. Verify electrodes for size, type, and condition.
5. Welding inspector shall be present during alignment and fit up of members being welded, and shall verify for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, inspector shall order the joint to be chipped down to sound metal, or gouged out, and rewelded. Thoroughly inspect root passes for cracks. Gouge out cracks and rewelded to 2 inches beyond each end of crack.
6. Inspector shall verify that welds have been marked with welder's symbol and shall mark welds requiring repairs and reinspection. Inspector shall maintain a written record of welds. Work completed and inspected shall receive an identification mark by the inspector. Identify unacceptable material and Work identified by word *reject* or *repair* marked directly on the material.
7. Testing agency shall advise the Owner and Architect of any shop and/or field conditions which may require further tests and examination by means other than those specified. Additional tests and examinations shall be performed as authorized by the Owner and Architect.

8. Owner reserves the right to use ultrasonic or radiographic inspection to verify adequacy of welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
9. Weld quality to comply with the American Institute of Steel Construction (AISC) Manual of Steel Construction.
10. Determine percentage of weld tested by the number of welds that fail the initial testing.
11. Reweld and retest welds that fail until the welds pass. Test two additional welds for every weld failure.

E. Inspect bolted construction in accordance with AISC *Specification for Structural Steel Buildings*:
1. Visually inspect bolts ensuring that plies have been brought into snug contact.
2. Inspect high strength bolt in accordance with Section 9 of the *Specifications for Structural Joints Using ASTM A325 or A490 Bolts*.

F. Inspect stud welding in accordance with Section 7.8, of AWS D1.1 *Structural Welding Code*:
1. Weld at least two shear studs at the start of each production period to determine correct generator, control unit, and stud welder setting. The studs shall be capable of being bent 45 degrees from vertical without weld failure.
2. When the temperature is below 32 degrees F (0 degrees C), test one stud in each 100 after cooling. Do not weld studs at temperatures below 0 degrees F or when surface is wet with rain or snow. If stud fails in the weld, two new studs shall pass the test before resumption of welding.
3. Visually inspect studs for compliance with the requirements of the Contract Documents. Verify 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, that stud shall be struck with a hammer and bent 15 degrees off perpendicular in the direction away from the missing weld. Studs failing test shall be replaced.

3.11 REINFORCING STEEL MECHANICAL SPLICES

A. Inspection and Observation Services:
1. Visually inspect and report on completed condition of each mechanical splice of reinforcing steel.
2. Visually inspect each mechanical splice to ensure compliance with the ICC-ES Reports and the manufacturer's published criteria for acceptable completed splices.
3. Place special emphasis on the inspection of the end preparation of each bar to be spliced required by the ICC-ES Report.

B. Reports: Submit reports to Architect:
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. Indicate reasons for rejection on each report.

3.12 OPEN WEB JOISTS AND JOIST GIRDERS

A. Inspect joists at jobsite for compliance with specified fabrication requirements. Verify welded connections between web and chord, splices, and straightness of members.

B. Inspect installation of joists at jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for compliance with Contract Documents and referenced standards.

C. Verify welder qualification certificates for both shop and field welding operators.

3.13 METAL FLOOR DECK

A. Field inspection shall consist of:
   1. Verifying types, gauges and finishes for compliance with Contract Documents and shop drawings.
   2. Examine composite floor deck exposed to crawl space for damage to galvanizing due to welding or construction activities. Repair galvanized composite floor deck in accordance with the specifications.
   3. Examine the erection of metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
   4. Certification of welders.
   5. Inspect and test field welded shear studs used to fasten metal floor decking to supporting steel as specified for structural steel.

3.14 METAL ROOF DECK

A. Field inspection shall consist of:
   1. Verify types, gauges and finishes for compliance with Contract Documents and shop drawings.
   2. Examine the erection of the metal deck, including fastenings at supports and side laps, reinforcing of holes, and miscellaneous deck supports.
   3. Certification of welders.
   4. Visual inspection of at least 25 percent of welds.

3.15 SPRAYED FIREPROOFING

A. Verify applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.

B. Verify installation complies with fire rating requirements of approved design.

C. Inspect and test for thickness:
   1. Test 25 percent of structural frame columns and beams in each building level.
   2. Test 10 percent of beams other than structural frame in each building level.
   3. Test one slab per 5,000 square feet of building area.

D. Inspect and test in accordance procedures of ASTM E605 and ASTM E736.

3.16 EXPANSION BOLT INSTALLATION

A. Inspect drilling of each hole and installation of each expansion bolt for compliance with Contract Documents and shop drawings.

B. Verify installation torque for each expansion bolt for compliance with manufacturer’s installation instructions.

3.17 LIGHTWEIGHT INSULATING CONCRETE FILL

A. Inspection and Observation Services (As required):
   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 Contractor to ascertain minimum withdrawal resistance of 40 pounds per fastener.

B. Testing Services (As required):

1. References (As applicable for tests required):
   a. American Society for Testing and Materials (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 – Standard 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 per 5,000 square feet.
      2) Not less than one for each day's Work.

4. Test EPS insulation board for density in accordance with ASTM C578.

3.18 TESTING OF ROOFING

A. Inspection and Observation Services (As required):
   1. Inspection of roof deck prior to start of Work.
   2. Inspect on site condition of stored roofing materials.
   3. Inspection during roofing, roof insulation, and sheet metal Work to ascertain compliance with Contract Documents.
   4. Observation of roof test cuts performed by Contractor to ascertain that they are properly made.
   5. Observation of patching of roof test cuts to ascertain that they are properly made.

B. Testing Services (As required):
   1. 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.

3.19 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.

   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.
   b. 28 Day Compressive Strength
   c. Water Retention
   d. 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 test per 2,000 square feet of masonry.

4. Refer to and include Work for reinforcing steel specified.
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) 28 Day Compressive Strength
      2) 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.
      3) Prism Test: Perform preconstruction 28 day compressive strength test on concrete masonry walls in accordance with ASTM E447-97, Method B.

3.20 REPAIR AND PROTECTION

A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 29.

B. Protect construction exposed by or for quality control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 45 23

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements for temporary utilities, support facilities, and security and protection facilities, including but not limited to:
1. Water service and distribution.
2. Sanitary facilities, including toilets, wash facilities, and drinking water facilities.
3. Heating and cooling facilities.
4. Ventilation.
5. Electric power service.
6. Lighting.
7. Telephone service.
8. Waste disposal facilities.
9. Field office.
10. Storage and fabrication sheds.
11. Lifts and hoists.
12. Construction aids and miscellaneous services and facilities.
13. Environmental protection.
14. Pest control.
15. Enclosure fence.
16. Security enclosure and lockup.
17. Barricades, warning signs, and lights.
18. Temporary partitions.
19. Fire protection.
20. Accessories necessary for a complete installation.

1.3 USE CHARGES

A. Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service: Pay sewer service use charges for water used and sewer usage by all entities for construction operations.

C. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.4 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Moisture Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged work.
3. Indicate sequencing of Work that requires water, such as sprayed fire resistive materials, plastering, and tile grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

C. Dust and HVAC Control Plan: Submit coordination drawing and narrative that indicates the dust and HVAC control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
1. HVAC system isolation schematic drawing.
2. Location of proposed air-filtration system discharge.
3. Waste handling procedures.
4. Other dust control measures.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board ADA-ABA Accessibility Guidelines (ADAAG), ICC/ANSI A117.1, and Texas Accessibility Standards (TAS) 2012.

B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.

B. Chain Link Fencing: Minimum 2 inch (50 mm), 0.148 inch (3.8 mm) thick, galvanized steel, chain link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8 inch (60 mm) OD line posts and 2-7/8 inch (73 mm) OD corner and pull posts.

C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils (0.25 mm) minimum thickness, with flame spread rating of 15 or less per ASTM E 84.

D. Dust Control Adhesive Surface Walk off Mats: Provide mats minimum 36 inches by 60 inches (914 mm by 1624 mm).

E. Insulation: Unfaced mineral fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame spread and smoke developed indexes of 25 and 50, respectively.

F. Lumber and Plywood: Comply with requirements in Section 06 10 00.

G. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; Type X or Type C panels with tapered edges. Comply with Section 09 29 00.

H. Paint: Comply with requirements in Section 09 90 00.

I. Tarpaulins: Fire resistive labeled with flame-spread rating of 15 or less.

J. Water: Potable.

2.2 TEMPORARY FACILITIES

A. Contractor's Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Provide elevated, stabilized concrete walkway from parking area to field offices.

B. Architect's Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Provide elevated, stabilized concrete walkway from parking area to field offices.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. Air Filtration Units: HEPA primary and secondary filter equipped portable units with four stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

C. Drinking Water: Containerized, tap dispenser, bottled water drinking water units, including paper cup supply. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 degrees F to 55 degrees F (7.2 degrees C to 12.7 degrees C).

D. Electrical Outlets: Properly configured, NEMA polarized outlets to prevent insertion of 110V to 120V plugs into higher voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

F. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid propane gas or fuel oil heaters with individual space thermostatic control.
   1. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
   2. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of **8** at each return air grille in system and remove at end of construction. Clean HVAC system as required in Section 01 77 00 and install new filter with MERV 11 or greater.

G. Air Filtration Units: Primary and secondary HEPA filter equipped portable units with four stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate facilities where they will serve project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
   1. Locate facilities to limit site disturbance as specified in Section 01 10 00.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. Install temporary service. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
   1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
   2. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
   1. Prior to commencing Work, isolate the HVAC system in area where Work is to be performed according to coordination drawings.
      a. Disconnect supply and return ductwork in Work area from HVAC systems servicing occupied areas.
      b. Maintain negative air pressure within Work area using HEPA equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
   2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust producing equipment. Isolate limited Work within occupied areas using portable dust containment devices.
   3. Perform daily construction cleanup and final cleanup using approved, HEPA filter equipped vacuum equipment.

G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations. Install electric power service underground unless otherwise indicated.
   1. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
      a. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length voltage ratio.
      b. Provide warning signs at power outlets other than 110 to 120 V.
      c. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or traffic areas.
      d. Provide metal conduit enclosures or boxes for wiring devices.
      e. Provide 4 gang outlets, spaced so 100 foot (30 m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
   2. Install lighting for Project identification sign.

J. Telephone Service: Provide temporary telephone service in common use facilities for use by construction personnel. Install one telephone line(s) for each field office.

   1. Provide dedicated telephone line for each facsimile machine in each field office.
   2. At each telephone, post a list of important telephone numbers.
      a. Police and fire departments.
      b. Ambulance service.
      c. Contractor's home office.
      d. Contractor's emergency after-hours telephone number.
      e. Architect's office.
      f. Engineers' offices.
      g. Owner's office.
      h. Principal subcontractors' field and home offices.

   3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

K. Electronic Communication Service: Provide a desktop computer and printer/scanner in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.
   1. Provide high speed wireless internet access (provide access to the Owner and Architect); DSL or broadband. Dial-up connection is not acceptable.
   2. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall.
   3. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
   4. Backup: External hard drive, minimum 1 terabyte, with automated backup software providing daily backups.

3.3 SUPPORT FACILITIES INSTALLATION

A. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.

1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 31 20 00.
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent pavement until immediately before Substantial Completion.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
   a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

G. Waste Disposal Facilities: Provide waste collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300.

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Elevator Use: Use of elevators is not permitted.

J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities to the satisfaction of Owner and Architect.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
   1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree or plant protection zones.
   2. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
   3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
   4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

G. Site Enclosure Fence: Before construction operations begin. Provide site enclosure fence to prevent people and animals from easily entering site except by entrance gates.
   1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each Work day.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
   1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Partitions: Provide floor to ceiling dustproof partitions to limit dust and dirt migration and to separate occupied areas occupied from fumes and noise.
   1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire retardant treated plywood on construction operations side.
   2. Construct dustproof partitions with two layers of 6 mil (0.14 mm) polyethylene sheet on each side. Cover floor with two layers of 6 mil (0.14 mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire retardant treated plywood. Do not apply tape to finish floor surfaces.
      a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water dampened foot mats in vestibule.

   3. Where fire resistance rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
   4. Insulate partitions to control noise transmission to occupied areas.
   5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
   6. Protect air handling equipment.
   7. Provide walk off mats at each entrance through temporary partition.

M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
   1. Prohibit smoking in construction areas.
   2. Supervise welding operations, combustion type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
   3. Develop and supervise an overall fire prevention and protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
   4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture Protection Plan: Avoid trapping water in finished Work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
   1. Protect porous materials from water damage.
   2. Protect stored and installed material from flowing or standing water.
   3. Keep porous and organic materials from coming into prolonged contact with concrete.
   4. Remove standing water from decks.
   5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
   1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
   2. Keep interior spaces reasonably clean and protected from water damage.
   3. Periodically collect and remove waste containing cellulose or other organic matter.
   4. Discard or replace water-damaged material.
   5. Do not install material that is wet.
   6. Discard, replace, or clean stored or installed material that begins to grow mold.

7. Perform Work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Condition Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
   1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
   2. Use permanent HVAC system to control humidity.
   3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits and moisture control.
      a. Hygroscopic materials that may support mold growth, including wood and gypsum based products, which become wet during the course of construction and remain wet for 48 hours are considered defective and are to be removed and replaced.
      b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
      c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24 hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion unless otherwise required and approved by Owner and Architect.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
   3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00"

END OF SECTION 01 50 00

SECTION 01 55 26 TRAFFIC CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work consists of furnishing traffic control devices and services for the control and protection of traffic through the area of construction in accordance with the Drawings and Specifications and in conformity with the details and at the locations shown on the approved plans for Temporary Traffic Control or as established by local ordinances and/or CalTrans Engineer.

B. Safe Traffic Flow to and through the project site shall be maintained at all times.

C. Traffic control shall conform to CalTran's encroachment permit requirements or as designated by local ordinances.

1.3 SUBMITTALS

A. Prior to beginning construction the Contractor shall apply for any and all traffic related permits and/or encroachments required by CalTrans or local jurisdictions. Provide detailed plans, indicating direction and placement of traffic altering devices including advanced warning signage, detour signage required for the project. Temporary Traffic Control plan must be approved by the Architect, subjected to CalTrans permitting prior to beginning construction activities.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

A. There will be no interruption of traffic on adjacent and feeder roads to the residential and commercial usage by maintaining a minimum of one-way traffic.

B. No construction shall begin until all traffic control signs and devices are installed by the Contractor.

END OF SECTION 01 55 26

SECTION 01 57 13.13 - FILTER FABRIC FENCE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This Section describes the installation of erosion and sedimentation control filter fabric fences (FFF) utilized during construction. The filter fabric fences are to be used to contain pollutants from overland flow. This practice shall not be used in channelized flow areas.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

A. The publications listed below forms a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. American Society for Testing and Materials (ASTM).

C. ASTM D-3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.

D. ASTM D-4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

A. Manufacturer's catalogue sheets and other pertinent information on geotextile fabric.

PART 2 - PRODUCTS

2.1 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140, with the appropriate opening size to be selected based on the grain size characteristics of the disturbed soil. Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.
Weight 8 ounces.

Representative Manufacturers: ADS Geosynthetics 0801T Nonwoven geotextile or preapproved equivalent.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide erosion and sedimentation control systems at the locations shown on the Drawings. Such

systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and set out in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.

C. Regularly inspect and repair or replace components of all erosion and sedimentation control systems as specified for each type of system. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project area stabilization is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials as required by these Specifications.

D. Remove and dispose sediment deposits at the project designated spoil site. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local regulations.

E. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately.

F. Contractor shall employ protective measures described in Section 01 57 19 - General Source Controls to avoid damage to existing trees to be retained on the project site. Conduct all construction operations under this Contract in conformance with the erosion control practices described in that Section.

3.2 CONSTRUCTION METHODS

A. Provide filter fabric fence systems at locations shown on the Drawings in accordance with the Detail at the end of this Section or on the Drawings, entitled "Filter Fabric Fence". Filter fabric fence systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the filter fabric to 1-inch by 2-inch wooden stakes spaced a maximum of 3 feet apart and embedded in the ground a minimum of 1 foot. If factory preassembled fence with support netting is used, spacing of the post may be increased to 8 feet maximum. The wooden stakes shall be installed at a slight angle toward the source of anticipated runoff.

C. Trench in the toe of the filter fabric fence with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow or for V-trench configuration as shown on the Detail. Lay filter fabric along the edges of the trench. Backfill and compact trench.

D. Filter fabric shall have a minimum height of 18 inches and a maximum height of 36 inches above the natural ground.

E. The filter fabric should be provided in continuous rolls and cut to the length of the Silt Fence to minimize the use of joints. When joints are necessary, the fabric should be spliced together only at a support post with a minimum 6-inch overlap and sealed securely.

F. Inspect sediment filter fabric fence systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once a week. Repair or replace damaged section immediately to restore the requirements of this Section. Remove sediment deposits when silt reaches one-third of the height of the fence in depth or 6 inches, whichever is less.

3.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this

section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END SECTION 01 57 13.13

SECTION 01 57 13.14 - REINFORCED FILTER FABRIC BARRIER

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This Section describes the installation of erosion and sedimentation control of reinforced filter fabric barriers (RFB) which must be utilized during construction. Reinforced filter fabric barrier is to be utilized to retain pollutants from passing downstream in channelized flow areas.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

A. The publications listed below forms a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM).

C. ASTM D-3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.

D. ASTM D-4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

A. Manufacturer's catalogue sheets and other pertinent information on geotextile fabrics.

PART 2 - PRODUCTS

2.1 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a minimum grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140, with the appropriate opening size to be selected based on the grain size characteristics of upstream disturbed soils. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.

Weight: 8 ounces

Representative Product: ADS Geosynthetics 801T Nonwoven geotextile or preapproved equivalent.

B. Provide woven galvanized steel wire fence with minimum thickness of 14 gauge and a maximum mesh spacing of 6 inches.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide erosion and sedimentation control systems at the locations shown on the Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.

B. Regularly inspect and repair or replace components of all erosion and sedimentation control systems as specified for each type of system. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project area stabilization is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials as required by these Specifications.

C. Remove and dispose sediment deposits at the project designated spoil site. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local regulations.

D. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately. Contractor shall employ protective measures described in Section 01560 - General Source Controls to avoid damage to existing trees to be retained on the project site. Conduct all construction operations under this Contract in conformance with the erosion control practices described in that Section.

3.2 CONSTRUCTION METHODS

A. Provide reinforced filter fabric barrier systems at locations specified on the Drawings in accordance with the Detail, found at the end of this Section or on the Drawings, entitled "Reinforced Filter Fabric Barrier". Filter fabric barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the woven wire support to steel fence posts (min. of 1.25 lbs. per linear foot & Brinell Hardness greater the 140) or 1-inch by 2-inch wooden stakes spaced a maximum of 6 feet apart and embedded a minimum of 8 inches. Steel post shall be made of hot rolled steel, at least 4 feet long with Tee or Y-bar sections with the surface painted or galvanized. Provide safety caps on top of metal posts. The posts shall be installed at a slight angle toward the source of the anticipated runoff.

C. Trench in the toe of the reinforced filter fabric barrier with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow as shown on the Detail. Lay filter fabric along the edges of the trench. Backfill and compact trench.

D. Reinforced filter fabric shall have a minimum height of 18 inches and a maximum height of 36 inches above the natural ground.

E. The filter fabric should be provided in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, the fabric should be spliced together only at a support post with a minimum 6-inch overlap and sealed securely.

F. Inspect sediment filter barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once a week. Repair or replace damaged section immediately to restore the requirements of this Section. Remove sediment deposits when silt reaches one-third of the height of the barrier in depth or 6 inches, whichever is less.

3.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION 01 57 13.14

SECTION 01 57 13.15 - STABILIZED CONSTRUCTION EXIT

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This Section describes the installation of erosion and sedimentation control for stabilized construction exits utilized during construction and prior to the final development of the site.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM).

C. ASTM D 4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

A. Manufacturer's catalog sheets and other pertinent information on geotextile fabric.

B. Sieve analysis of aggregates conforming to requirements of this Section.

PART 2 - PRODUCTS

2.1 SEPARATION GEOTEXTILE

A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. 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, with the appropriate opening size to be approved in the review process based on the characteristics of the disturbed material. 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 six months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F. Representative Manufacturers: TenCrate Mirafi or preapproved equivalent.

2.2 COARSE AGGREGATES

A. Coarse aggregates shall consist of crushed stone, gravel, crushed blast furnace slag, or combinations thereof. 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.

Sieve Size (Square Mesh)	Percent Retained (By Weight)
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 GENERAL

A. To keep the street clean of mud generated by construction vehicles and equipment, Contractor shall provide stabilized construction exits at the construction site, staging, parking, storage, and/or disposal areas. Such erosion and sediment control system shall be constructed in accordance with the Detail - Stabilized Construction Exit attached hereto or shown on the Drawings, and any additional requirements shown on the Drawings and set out in this Section.

B. No clearing and grubbing or rough cutting, other than as specifically directed by the Owner to allow soil testing and surveying, shall be permitted until erosion and sedimentation control systems are in place.

C. Maintain existing erosion and sedimentation control systems located within the project site until acceptance of the project or until directed by the Owner to remove and discard the existing system.

D. Regularly inspect and repair or replace components of stabilized construction exists. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials offsite.

E. Remove and dispose sediment deposits at the project designated spoil site. If a project spoil site is not designated on the Drawings, dispose of sediment offsite at location not in or adjacent to stream or floodplain. Off-site disposal will be 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 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 of the Contractor, or on-site for his use, shall be prohibited from maneuvering on areas outside of the construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately.

G. Conduct all construction operations under this Contract in conformance with the erosion control practices described in the Section 01 57 13 - General Source Controls.

3.2 CONSTRUCTION METHODS

A. Provide stabilized exits, entrances, access roads, parking areas, and other on-site vehicle transportation routes where shown on the Drawings.

B. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto area roadways. 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.

C. Details for stabilized construction exit are shown on the Detail herein or as shown on the Drawings. Construction of other stabilized areas shall be to the same requirements. Roadway width shall be at least 30 feet and shall be sufficient for all ingress and egress to the site. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlaying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of fourteen days to minimize damage potential.

D. 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 area roadways, receiving stream or storm water conveyance system.

E. 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 measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto area roadways shall be remove immediately.

F. The length of the stabilized area shall be as shown on the Detail or as shown on the Drawings, but not less than 50 feet in length. The thickness shall not be less than 8 inches. The width shall not be less than full width of all points of ingress or egress.

G. Stabilization for other areas shall have the same thickness, and width requirements as the stabilized construction exit, except where specified otherwise on the Drawings. The aggregate shall be a compacted limestone base material, 8 inches in thickness, with an application of emulsified asphalt. The emulsified asphalt material shall be reapplied periodically following any regrading of the limestone surface.

H. Stabilized area may be widened or lengthened to accommodate truck-washing area as required by the Contractor and approved by the Owner.

I. Alternative methods of construction, when preapproved by the Owner, may 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.

3.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this Section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION 01 57 13.15

SECTION 01 57 26 - TEXAS POLLUTION DISCHARGE ELIMINATION SYSTEM (TPDES)

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This project is subject to the Texas Commission on Environmental Quality (TCEQ) Texas Pollution Discharge Elimination System (TPDES) Construction Storm Water Discharge Regulations and Requirements. The Contractor will be required to execute a Notice of Intent (NOI) and implement the Pollution Prevention Plan included in the Contract Documents and comply with all reporting and inspection requirements set forth in the TPDES regulations.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Supplementary Conditions, and relevant Division 2 Specification Sections, apply to this Section.

1.3 SUMMARY

A. The Contractor shall be responsible for the preparation, implementation, maintenance, and inspection 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 practices described in the Storm Water Pollution Prevention Plan (SWPPP) Drawing, and as specified elsewhere in this or other Technical Specifications.

B. Contractor shall present his plan for implementation of the SWPPP in a meeting with the Owner/Architect/Engineer prior to start of construction.

1.4 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. The components shall consist of the control measures necessary to comply with the NPDES and The Clean Water Act. Example erosion and sediment control measure components are found on the Storm Water Pollution Prevention Plan Drawing, and this or other Technical Specifications.

PART 3 - EXECUTION

3.1 NOTICE OF INTENT / CERTIFICATION REQUIREMENTS

A. The Contractor shall execute, along with the Contract Documents, a Contractor/Subcontractor Certification, which shall identify the responsibilities for construction activity during the contract. Each Subcontractor’s responsibility with regard to the SWPPP shall be identified.

B. The Contractor shall be responsible for signing the certification statement of the NOI.

C. A copy of the NOI shall be posted in a prominent place for public viewing at the project site. The Contractor shall be responsible for execution of all documents and providing all inspections and

certifications outlined in the SWPPP as necessary for compliance with federal, state and local guidelines.

D. The executed Notice of Intent shall be sent to:

BY REGULAR U.S. MAIL

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC-228
P.O. Box 13087
Austin, Texas 78711-3087

3.2 RETENTION OF RECORDS

A. The Contractor shall retain a copy of the SWPPP from the date that it became effective to the date of project completion.

B. Contractor shall retain copies of all inspection and maintenance reports, as well as copies of all modifications and adjustments to the SWPPP until the date of project completion.

C. Contractor shall return to the Owner, all records stated above at the completion of the project. Owner will retain all SWPPP records and data for a period of three (3) years from the date project completion.

3.3 REQUIREMENTS

A. The following notices are to be posted from the date that the SWPPP goes into effect until the date of final stabilization:
1. Copies of the Notice of Intent, submitted by the Owner and General Contractor, along with the Project Description Form of the SWPPP, are to be posted at the construction site or at the Contractor's office in a prominent place for public viewing.
2. Notice to drivers of equipment/vehicles to stop, check, and clean tires for debris and mud before equipment/vehicles can enter traffic lanes are to be posted at every stabilized construction exit area.
3. Notice of waste disposal procedures are to be posted at a location onsite.
4. Notice of hazardous material handling and emergency procedures are to be posted with the NOI on site. Copies of Material Safety Data sheets are to be kept at a location onsite that is clearly made known to all personnel.
5. A copy of the signed Certification forms included in this Section shall be kept at the construction site or at the Contractor's office.

B. Construction may not begin until 60 days after the NOI is filed.

C. Construction sites that will disturb 10 acres or more shall meet current numeric discharge limit requirements.

D. If earth disturbance will be stopped for 14 days or more, the contractor must immediately stabilize the area using straw or hydraulic mulch, soil binders, erosion control blankets, or hydroseeding.

3.4 NOTICE OF TERMINATION

A. A Notice of Termination (NOT) of Coverage under the TPDES General Permit for Storm Water Discharges Associated with Industrial Activity and storm water run-off from the construction activities does not cause sediment transport or erosion from the site. The A/E and inspector will make final determination of the final stabilization. Final stabilization is when all soil-disturbing activities at the site have been completed and when a uniform perennial vegetative cover with a

density of 85% of the cover for unpaved areas has been established. The Contractor will be required to maintain structural controls until this vegetative cover meets the above requirement.

3.5 ATTACHMENTS

For the current forms, visit the TCEQ's website at:
https://www.tceq.texas.gov/assistance/water/stormwater/sw-construction.html#tpdes.

END OF SECTION 01 57 13.15

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for selection of products, including but not limited to:
   1. Product delivery, storage, and handling.
   2. Manufacturers' written warranties on products.
   3. Special warranties.
   4. Comparable products.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term *product* includes the terms *material*, *equipment*, *system*, *assembly*, and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis of Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words *basis of design product*, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Include data to indicate compliance with the specified requirements.
   2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
      a. Form of Approval: As specified in Section 01 33 00.

b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis of Design Product Specification Submittal: Comply with requirements in Section 01 33 00. Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:
1. Schedule delivery to minimize long term storage at site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
   1. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
   2. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 77 00.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and items needed for complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term “as selected”, Architect will make selection.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:
   1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   3. Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   5. Basis of Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and characteristics based on the product named. Comply with requirements for consideration of an unnamed product by one of the named manufacturers.

C. Visual Matching Specification: Where Specifications require “*match Architect's sample”*, provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
   1. If no product available within specified category matches and complies with specified requirements, comply with requirements of Section 01 25 00 for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase “*selected by Architect”* or similar phrase, select a product that complies with requirements. Architect will select color,

gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
   1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   3. Evidence that proposed product provides specified warranty.
   4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
   5. Samples, if requested.

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Coordination of Owner-installed products.
   5. Progress cleaning.
   6. Starting and adjusting.
   7. Protection of installed construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair Work required to restore construction to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Certificates: Submit certificate signed by **land surveyor or professional engineer** certifying that location and elevation of improvements comply with requirements.

B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

C. Certified Surveys: Submit two copies signed by land surveyor.

D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor legally qualified to practice in the State of Texas, who is experienced in providing land surveying services of the kind indicated.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. In Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not warranted. Before beginning site Work, investigate and verify existence and location of underground utilities, mechanical and electrical systems, and construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water service piping; underground electrical services, and other utilities.
2. Furnish location data for Work related to the Work that must be performed by public utilities serving the site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation after correcting unsatisfactory conditions. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
   1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as necessary to locate each element of Project.
   2. Establish limits on use of site.
   3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   4. Inform installers of lines and levels to which they must comply.
   5. Check the location, level and plumb, of every major element as the Work progresses.
   6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
   7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical Work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control Work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
   2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other Work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical Work plumb and make horizontal Work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions ensuring the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous. Materials containing asbestos and BCPs are prohibited.

3.6 OWNER INSTALLED PRODUCTS

A. Site Access: Provide access to site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with Work performed by Owner's construction personnel.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's Work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

A. Clean site and Work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F (27 degrees C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
   a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with mechanical, plumbing, and electrical requirements.

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 73 29 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Procedural requirements for cutting and patching.

1.3 RELATED DOCUMENTS

A. Document 00 73 00 – Supplementary Conditions to the Contract: Article 3.14.3.

1.4 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair Work required to restore surfaces to original conditions after installation of other Work.

1.5 SUBMITTALS

A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
   1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
   2. Changes to In Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
   3. Products: List products used for patching and firms or entities that will perform patching Work.
   4. Dates: Indicate when cutting and patching will be performed.
   5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
      a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.6 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

B. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

C. Operational Elements: Do not cut and patch operating elements and related components that results in reducing the capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
   1. Primary operational systems and equipment.

2. Fire separation assemblies.
3. Air or smoke barriers.
4. Fire suppression systems.
5. Mechanical systems piping and ducts.
6. Control systems.
7. Communication systems.
8. Fire-detection and -alarm systems.
9. Conveying systems.
10. Electrical wiring systems.
11. Operating systems of special construction.

D. Miscellaneous Elements: Do not cut and patch the following elements or related components that change the load bearing capacity, resulting in a reduction of capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise and vibration control elements and systems.
7. Sprayed fire resistive material.

E. Visual Requirements: Do not cut and patch construction resulting in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer or fabricator to cut and patch exposed Work. If possible, engage original Installer or fabricator. If original installer is not available, engage recognized, experienced, and specialized firm for the Work.
   a. Processed concrete finishes.
   b. Ornamental metal.
   c. Matched veneer woodwork.
   d. Preformed metal panels.
   e. Roofing.
   f. Firestopping.
   g. Window system.
   h. Fluid applied flooring.
   i. Wall covering.
   j. HVAC enclosures, cabinets, or covers.

F. Cutting and Patching Conference: Before proceeding, meet at site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with specified requirements.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Services: Where removal, relocation, or abandonment is necessary, bypass existing services before cutting to avoid interruption of services to occupied areas.

3.3 CUTTING AND PATCHING

A. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at earliest feasible time, and complete without delay.
   1. Cut existing construction to provide for installation of components or performance of construction, and subsequently patch as necessary to restore surfaces to an original condition.

   2. Cut in place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of Work to be cut.

C. Protection: Protect in place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00.

E. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. Use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable earthwork specifications by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction to eliminate evidence of patching and refinishing.
      a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
      b. Restore damaged pipe covering to its original condition.
   3. Floors and Walls: Where walls or partitions are removed, extend one finished area into another, patch and repair surfaces in new space. Provide even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
   4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
   5. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
   6. Exterior Building Enclosure: Patch components and restore enclosure to a weathertight condition.

END OF SECTION 01 73 29

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 PRE-CLOSEOUT MEETING

A. Pre-Closeout Meeting: Schedule and convene Pre-Closeout Meeting with Owner and Architect in accordance with Section 01 31 00, Project Coordination and Management.

1.3 SUBSTANTIAL COMPLETION

A. The items listed in the Supplementary Conditions, Paragraph 9.8 and the following items shall be completed before Substantial Completion will be granted:
   1. Contractor's Completion List (Punch List): Submit a thorough list of items to be completed or corrected, along with a written request for Substantial Completion and for review of the Work or portion of the Work. The Architect/Engineer's Project Representative, at their discretion, may attend and assist in the preparation of the Contractor's Punch List.
   2. Architect's Supplemental Punch List: The Architect/Engineer, along with the Owner at the Owner's discretion, will inspect the Work utilizing the Contractor's prepared Punch List, noting completed items and incomplete items, and will prepare a supplemental list of items that have been omitted or incomplete items that were not previously noted.
   3. Operations and Maintenance Manuals: Submit as described in paragraph 1.3.
   4. Final Cleaning: Provide final cleaning and adequate protection of installed construction as described in paragraph 1.6 and 1.7.
   5. Starting of systems: Start up equipment and systems as described in paragraph 1.8.
   6. Testing and balancing: Testing and balancing of systems must be performed and completed by Owner's forces, and the report submitted and accepted by Architect/Engineer and Owner, as described in the Contract Documents. Make adjustments to equipment as required to achieve acceptance.
   7. Demonstrations: If required by individual specification sections or by Owner, provide demonstrations and instructions for use of equipment as described in paragraph 1.9.

B. Date of Substantial Completion: Complete or correct items identified on Punch List and confirm that all items have been corrected prior to Architects re-inspection. Architect/Engineer, along with the Owner, will re-inspect the corrected work to establish the Date of Substantial Completion. Incomplete items remaining will be appended to the Certificate of Substantial Completion (AIA G704). The Date of Substantial Completion represents day one (1) of the closeout period, and represents the date of commencement of the Contractors correctional period and all warranty periods as described and required by the Contract Documents, except as amended in the Certificate of Substantial Completion and elsewhere in the Contract Documents.

C. Certificate of Substantial Completion: When the Work or designated portion thereof is substantially complete, Architect will prepare the Certificate of Substantial Completion to be executed by the Owner and Contractor. Items on the appended Punch List shall be completed or corrected within the time limits established in the Certificate.

1.4 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 I 00% 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 will be no longer than five (5) typed pages.

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.

1.5 OPERATIONS AND MAINTENANCE MANUAL

A. As a requirement for Substantial Completion, the final Operation and Maintenance Manual shall be submitted to, and reviewed and accepted by the Architect prior to issuance of the Certificate.

B. Prepare 3-ring D-slant binder cover and spline with printed title "OPERATIONS AND MAINTENANCE MANUAL", title of project, and subject matter of binder when multiple binders are required.

C. Submit one (1) copy of preliminary Operations and Maintenance Manuals to respective consultants (Civil, MEP, Structural, *etc*.) for review of conformance with contract requirements prior to submitting final to Architect. Allow time for proper review.

D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

F. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and Maintenance, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Equipment start-up instructions
      e. Operating instructions.
      f. Maintenance instructions for equipment and systems.
      g. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

   3. Part 3: Project documents and certificates, including the following:
      a. Product data.
      b. Air and water balance reports.
      c. Photocopies of warranties, certificates and bonds. Submit originals with Closeout Documents as specified below.

G. Submit one (1) final original and two (2) copies to Architect.

H. Contractor shall provide a DVD, in PDF Format, the following documents after approval by the Architect, Consultants and Owner: closeout manual, MSDS binder, O&M Manuals, specifications and approved submittals. Documents shall be hyper-linked to the Table of Contents.

1.4 PROJECT CLOSEOUT

A. Final Payment will not be authorized by the Architect until the Architect finds the Work acceptable under the Contract Documents, subject to the completion and acceptance of the following requirements and other applicable Contract requirements:
   1. Close-out Documents: Provide bound closeout documents as described in paragraph 1.5. Refer to the Supplementary Conditions, Paragraph 9.10 for additional information.
   2. Record Documents: Submit as described in paragraph 1.10.
   3. Extra materials: Provide extra stock, materials, and products as described in paragraph 1.11 when required by individual specification sections.

4. Locks: Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
5. Temporary Facilities: Discontinue and remove temporary facilities from the site, along with mockups, construction aids, and similar elements.
6. Warranties, Certificates and Bonds: Execute and assemble transferable warranty documents, certificates, and bonds from subcontractors, suppliers, and manufacturers as described in paragraph 1.12.
7. Final Inspection and Acceptance by Architect is achieved as described in paragraph 1.13.

1.5 CLOSEOUT DOCUMENTS

A. Coordinate the following items with the requirements of Document CB, Supplementary Conditions of the Contract.

B. Prepare 3-ring D-slant binder cover and spline with printed title "CLOSEOUT DOCUMENTS", title of project, and subject matter of binder when multiple binders are required. Submit one (1) original and two (2) copies.

C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. The close-out documents shall be neatly organized and easily useable as determined by the Architect and Owner. Separate Close-out Documents binders from Operations and Maintenance Manuals. Documents identified as "affidavit" shall be notarized.

E. Contents: Prepare Table of Contents for each volume, with each item description identified, typed on white paper, in five (5) parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers. All General Contractor's vendors/suppliers and subcontractors that provided materials or performed any work related to this project must be listed on this form. Submit Final List of Subcontractors on Document AD.
   2. Part 2: Closeout Documents and Affidavits, include the following:
      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;

   3. Part 3: Project documents and certificates, including the following:
      a. Copy of Certificate of Substantial Completion (AIA G704);
      b. Copy of All Permits;
      c. Copy of Final Utility Bill or letter of transfer;
      d. Copy of Certificate of Occupancy;
      e. Copy of Certification of Project Compliance: Submit on attached **Close-out Form "B"**. Owner and Architect will initiate form and forward to Contractor for signature once Substantial Completion is established. (Owner to be provided original separately);

   4. Part 4: Warranties, Release of Liens, compile sequentially based on specification sections:
      a. General Contractor's Warranty: Submit on company letterhead as described below. This Warranty shall state all sections of Work performed by General Contractor's own forces, and warranty period for each section of Work;
      b. Subcontractor's Release of Lien: Include contractor's, subcontractor's and direct material and equipment supplier's separate final releases. Submit on attached **Close-out Form "A"** – Subcontractor's Affidavit of Release of Lien.

c. Hazardous Material Certificate: Submit on attached **Close-out Form "C"**. Affidavits from Contractor, Subcontractors and General Contractor's vendors or suppliers stating that no hazardous materials/products have been used or installed in this project.
d. Subcontractor's Warranty: notarized, and submitted on attached **Close-out Form "D"**. This Warranty shall state all sections of Work performed by the subcontractor and warranty period.
e. Special / Extended Warranties; List and provide, notarized warranties requested by Owner, or required by or incorporated in the Contract Documents.
f. Spreadsheet depicting all items and materials that carry a warranty longer than one (1) year. Include information consisting of material/ supplier/ installer/ specification section/ length of warranty and contact information.

5. Part 5: Receipts:
a. Extra Stock: Provide original receipts for delivery of "Extra Stock" items as described below. Receipts must be signed by an authorized Owner's representative;
b. Keys: Provide original receipts for delivery of "Keys". Receipts must be signed by an authorized Owner's representative.
c. Sign in sheets: provide signatures of attendees from all demonstrations.

F. In addition to the three (3) required close-out binders listed above, provide Architect with one (1) separate binder for their records containing the following:
1. Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers;
2. All MSDS sheets for the project;
3. All warranties from Contractor, subcontractors, direct suppliers, and manufacturers.

G. Failure to complete and close-out project after substantial completion may result in liquidated damages being assessed to the Contractor. Refer to Conditions of the Contract for additional requirements and liquidated damages.

1.6 FINAL CLEANING

A. Execute final cleaning prior to final project inspection and acceptance.

B. Clean interior and exterior glass, and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces, mop hard floor surfaces.

C. Remove smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces

D. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.

E. Clean and replace filters of operating equipment as required by Contract Documents

F. Clean debris from roofs, gutters, downspouts, and drainage systems.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste and surplus materials, rubbish, and temporary construction facilities from site.

1.7 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections until Work is accepted by Architect and Owner.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

1.8 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect/Engineer and Owner 48 hours prior to start-up of each item.

C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of Contractors' personnel, and installer in accordance with manufacturers' instructions.

G. When specified in individual specification sections or required by manufacturer, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. When specified in individual specification sections or required by Owner or Architect/Engineer, submit a written report in accordance with Section 01 33 00, Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.

1.9 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel a minimum of 48 hours prior to date of Final Completion in accordance with Owner’s requirements.

B. Demonstrate Project equipment instructed by qualified manufacturer's representative who is knowledgeable about the Project and equipment.

C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.

D. Utilize maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel to explain all aspects of operation and maintenance.

E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.

F. Prepare and insert additional data in maintenance manuals when need for additional data becomes apparent during instruction.

G. Review and verify proper star-up and operation of equipment prior to scheduling demonstrations with Owner.

H. All demonstrations are to be documented by video and submitted to the Owner in DVD format along with the close out documents. General contractor is responsible for all video and compilation onto DVD with linked menus.

1.10 PROJECT RECORD DOCUMENTS

A. Project Record Documents, as described in Section 01 78 39, shall be submitted at Project Closeout. Final Payment will not be authorized by the Architect until final review and acceptance by Architect and Engineers is achieved in accordance with the Owners requirements.

B. At the Contractors request, and with associated fee, Architect may provide electronic versions of the construction drawing and specification files for Contractors use, subject to the terms and conditions of Architects standard electronic document transfer agreement.

C. Submit reproducible to respective consultants (Civil, Structural, MEP, *etc*.) for review. Consultant will mark-up corrections and return to Contractor for final revisions. Make final revisions prior to submitting to Architect.
   1. Format: One (1) set of film positive reproducibles and two (2) sets bluelines of approved reproducibles.
   2. Provide the Owner with one (1) set of Record Drawings on a non-rewritable CD in AutoCAD® latest release.
   3. Provide the Owner with one (1) set of Record Drawings on a on a non-rewritable CD in PDF format.
   4. Label electronic CAD files and PDF files in the same manner as the sheets (example, A2.02 First Floor Area ‘A’, etc.)

1.11 EXTRA STOCK, MATERIALS AND MAINTENANCE PRODUCTS

A. Furnish extra stock, maintenance, and extra products in quantities specified in individual specification sections.

B. Deliver to Project site or to District Maintenance Department as directed by Owner; obtain signed receipt from Owner’s authorized representative prior to final application for payment. Delivery of materials to, or obtaining receipt from anyone other than Owner’s authorized representative may constitute breach of this requirement and may require delivery of additional materials at no cost to the Owner if original materials are misplaced.

C. Include signed receipts for delivery of extra stock and materials, including keys, with Closeout Documents.

1.12 WARRANTIES, CERTIFICATES AND BONDS

A. Definitions:

1. Standard Product Warranties: preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
2. Special Warranties: written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide coverage of specific defects, or both.

B. In accordance with the general warranty obligations under Paragraph 3.5 of the General Conditions as amended by the Supplementary Conditions, the General Contractor's warranty shall be for a period of one (1) year following the date of Substantial Completion, hereinafter called the one-year warranty period. The Contractors one-year general warranty shall include all labor, material and delivery costs required to correct defective material and installation. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.

C. The Contractor's one-year warranty shall run concurrently with the one (1) year period for correction of Work required under Paragraph 12.2 of the General Conditions.

D. No service charges or call out charges are allowed to investigate warranty claims.

E. In addition to the Contractors one-year warranty, Special Warranties as described in individual specifications sections, shall extend the warranty period for the period specified without limitation in respect to other obligations which the Contractor has under the Contract Documents.

F. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve the suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

G. Warranty Requirements:
1. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
2. When Work covered by a warranty has failed and been corrected by replacement or reconstruction, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
3. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
4. Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
5. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or designated portion of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

H. Compile copies of each required warranty properly executed by the Contractor and the subcontractor, supplier, or manufacturer. Verify documents are in proper form, contain full information, and are notarized. Co-execute warranties, certificates and bonds when required and include signed warrantees with Closeout Documents submitted to the Architect.

1.13 FINAL COMPLETION AND FINAL PAYMENT

A. Final Notice and Inspection:

1. When all items on the Punch List have been corrected, final cleaning has been completed, and installed work has been protected, submit written notice to the Architect that the Work is ready for final inspection and acceptance.
2. Upon receipt of written notice that the Work is ready for final inspection and acceptance, the Architect and Engineer will make final inspection.

B. Final Change Order: When the Project Closeout items described above are successfully completed and the Work is found acceptable to Architect/Engineer and Owner, a Final Change Order will be executed. This Change Order will include any Allowance adjustments as required by the Contract Documents.

C. Final Application for Payment: When all of the above items are successfully complete, submit to the Architect a final Application for Payment and request for release of retainage.

D. Release of Retainage: Release of retainage will not be authorized by the Architect until Contractor completes all requirements for close-out to the satisfaction of the Owner and Architect as described herein.

1.14 TERMINAL INSPECTION

A. Immediately prior to expiration of the one (1) year period for correction of the Work, the Contractor shall make an inspection of the work in the company of the Architect and the Owner. The Architect and the Owner shall be given not less than ten (10) days notice prior to the anticipated date of terminal inspection.

B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, the Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of the Architect and the Owner, even if the date of completion of the corrective work may extend beyond the expiration date of the correction period.

C. The Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by the Owner nor the replacement of parts necessitated by normal wear in use.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 77 00

SECTION 01 77 00 CLOSEOUT FORMS

CLOSE-OUT FORM "A"

SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the _____ of _____, the subcontractor who supplied, installed, and /or erected the work described below, and that, he /she is duly authorized to make this Affidavit and Subcontractor Release:

   Project: PKG 3A – GPHS New Fieldhouse
   Owner: Galena Park Independent School District Architect: PBK
   Work Performed: _____ Specification Section(s): _____

2. That all work required under the subject subcontractor of the subject construction project has been performed in accordance with the terms thereof, that all material men, sub-subcontractors, mechanics, and laborers have been paid and satisfied in full and that there are no outstanding claims of any character arising out of the performance of said subcontractor which have not been paid and satisfied in full.

3. That to the best of his / her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said subcontract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.

4. That he / she has received full payment of all sums due him / her for materials furnished and services rendered by the undersigned in connection with the performance of said subcontract and has and does hereby release the Owner and the Architect and his consultants and the Contractor from any and all claims of any character arising out of or in any way connected with performance of said subcontract.

ATTEST (If Corporation)

_____
Name of Subcontractor

_____ _____
Secretary (By) (Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20_____.

(Seal)

_____
(Notary Public Signature)

CLOSE OUT FORM "B"

CERTIFICATION OF PROJECT COMPLIANCE

Completion of this form is required under the provisions of §61.1040 19 TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

1. PROJECT INFORMATION

DISTRICT:

Facility:

ARCHITECT/ENGINEER:

Address:

CONTRACTOR/CM:

City:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT:

2. CERTIFICATION OF DESIGN AND CONSTRUCTION

The intent of this document is to assure that the school district has provided to the architect/engineer the required information and the architect/engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

3. The District certifies the following:

1.) The educational specifications of this facility presented to the school board of trustees were provided to the prime design professional in a timely manner.

2.) The long range facility plan was developed presented to the school board and provided in a timely manner to the prime design professional in a timely manner.

3.) That a design professional was hired to achieve the goals and expectations of the long range facility plan, and if applicable educational specifications.

4.) The safety and security standards were provided as a directive in a timely manner to the architect.

DISTRICT: **BY:** **DATE:**

4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the project has been designed in reasonable accordance with the long range facility plan and educational specifications based on the School Facilities Standards as adopted by the Commissioner of Education, November 1, 2021, and as provided by the district. This includes the compliance path directives of section (g) or (h) and the safety and security directives in section (k) found in the above standard.

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

5. The Contractor/CM the project has been built in reasonable accordance with the long range facility plan and educational specifications based on the School Facilities Standards as adopted by the Commissioner of Education, November 1, 2021, and as provided by the district. This includes the safety and security directives in section (k) found in the above standard. In addition, certifies that the building has been found to not have any violations by the local authority of jurisdiction or third party code inspector.

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

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

DISTRICT: **BY:** **DATE:**

INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE" FORM

Section 1. Identify the following:
- – name and address of the school facility
- – name of the school district
- – the Architect/Engineer and Contractor
- – the date of execution of the construction contract
- – the date that the school district authorized the superintendent to hire an architect/engineer
- – scope of the project.

Section 2. This section outlines the intent of the document. No action required.

Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

Section 4. This section is to be executed by the architect/engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.1040, School Facilities Standards) and returned to the school district's files.

Section 5. This section is to be executed by the contractor upon substantial completion of the project and retained in the school district's files.

Section 6. This section is to be executed by the school district upon acceptance and occupancy of the project.

NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY. The school district will retain this document in their files indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

CLOSE-OUT FORM "C"

SUBCONTRACTOR HAZARDOUS MATERIAL CERTIFICATE

THE STATE OF _____

COUNTY OF _____

PROJECT: PKG 3A – GPHS New Fieldhouse

OWNER: Galena Park Independent School District

ARCHITECT: PBK

SPECIFICATION SECTION(S):

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says that he / she is the _____ of _____,the subcontractor / supplier who constructed or provided the section(s) of work referenced above, and that he / she is duly authorized to certify to the best of his / her information, knowledge, and belief no asbestos, lead or PCB containing products have been incorporated into the project.

ATTEST (If Corporation)

_____
Name of Subcontractor / Supplier

_____ _____

_____ Secretary (By)
(Title)

JURAT

THE STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20_____.

_____
(Seal) (Notary Public Signature)

CLOSE-OUT FORM "D"

SUBCONTRACTOR WARRANTY

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the Subcontractor (or the _____of_____ the subcontractor) who supplied, installed, and / or erected the work described below, and that, he / she is duly authorized to make this Subcontractor Warranty:

   Project: PKG 3A – GPHS New Fieldhouse
   Owner: Galena Park Independent School District Architect: PBK
   Work Performed: _____Specification Section(s): _____

2. The undersigned Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

3. In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Subcontractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, Owner or Architect.

4. The Subcontractor warrants the work performed for a period of _____ months from the date of Substantial Completion, except as follows:_____
   _____

ATTEST (If Corporation)

_____
Name of Subcontractor

_____
Secretary (By) (Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

_____
(Seal) (Notary Public Signature)

SECTION 01 77 02 - WAIVER AND RELEASE OF LIENS

PART 1 GENERAL

1.1 SUMMARY

A. Document Includes: Applicability and use of statutory Waiver and Release of Lien forms promulgated by the Legislature of the State of Texas for construction projects in Texas.

B. Related Requirements:
   1. The Contract for Construction (also referred to as the Agreement or the Contract)
   2. Conditions of the Contract (General, Supplementary, and other conditions, if any)
   3. Section 01 29 00 Payment Procedures
   4. Section 01 77 00 Contract Closeout
   5. Section 01 77 01 Closeout Procedures

1.2 REFERENCES

A. Texas Property Code, Chapter 53, Subchapter L, Sections 53.281 thru 53.287 (includes the standard forms attached herewith immediately following this section):
   1. Form 1: Conditional Waiver for Progress Payments
   2. Form 2: Unconditional Waiver for Progress Payments
   3. Form 3: Conditional Waiver for Final Payments
   4. Form 4: Unconditional Waiver for Final Payments

PART 2 PRODUCTS *(not used)*

PART 3 EXECUTION

3.1 SELECTION AND USE OF WAIVER AND RELEASE OF LIEN FORMS

A. Based on answers to the following questions, use the applicable form for the occasion:
   1. Is the payment a *progress* payment (partial, not final), or a *final* payment?
   2. Is the release *unconditional* (for a payment already received), or *conditional* (given in anticipation of a payment not yet received)?

B. Submit the applicable form, properly executed (filled out, signed and dated) and notarized, on each occasion required (see other portions of the Contract Documents, including but not necessarily limited to the related requirements documents cited above).

C. The wording of these forms is prescribed by the State of Texas. Questions regarding their use, execution, etc. should be directed to user's own attorney experienced in construction or lien law. This document is not to be interpreted as rendering legal advice.

D. Even if the Contract Documents do not explicitly require submittal of Waivers and Releases of Liens for every payment (for example, omitting them for monthly progress payments), the Owner reserves the right, at its sole discretion, to require applicable Waivers and Releases of Liens, executed and notarized, for any or all payments.

END OF DOCUMENT AI

(see following pages for standard forms)

FORM 1: CONDITIONAL WAIVER FOR PROGRESS PAYMENTS

PROJECT NAME: _____

OWNER'S NAME: _____PROJECT NUMBER_____

CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

On receipt by the signer of this document of a check from _____ (maker of check) in the sum of $_____ payable to _____ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of _____ (owner) located at _____ (location) to the following extent:

_____ (job description).

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date _____

_____ (Company name)

By _____ (Signature)

_____ (Printed/Typed name)

_____ (Title)

SWORN AND SUBSCRIBED before me at _____, _____, This _____ day of _____, 20____ A.D.

_____

Notary Public in and for the state of _____

FORM 2: UNCONDITIONAL WAIVER FOR PROGRESS PAYMENTS

PROJECT NAME: _____

OWNER'S NAME: _____ PROJECT NUMBER_____

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

The signer of this document has been paid and has received a progress payment in the sum of $_____ for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) on the property of _____ (Owner) located at _____ (location) to the following extent: _____ (job description). The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the above referenced project to the following extent:

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date _____

_____ (Company name)

By _____ (Signature)

_____ (Printed/Typed name)

_____ (Title)

SWORN AND SUBSCRIBED before me at _____, _____, This ____ day of _____. 20____ A.D.

_____

Notary Public in and for the state of _____

FORM 3: CONDITIONAL WAIVER FOR FINAL PAYMENTS

PROJECT NAME: _____

OWNER'S NAME: _____ PROJECT NUMBER_____

CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Project _____

Job. No. _____

On receipt by the signer of this document of a check from _____ (maker of check) in the sum of $_____ payable to _____ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of _____ (owner) located at _____ (location) to the following extent:

_____ (job description).

This release covers the final payment to the signer for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted).

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date _____

_____ (Company name)

By _____ (Signature)

_____ (Printed/Typed name)

_____ (Title)

SWORN AND SUBSCRIBED before me at _____, _____, This ____ day of _____. 20____ A.D.

_____

Notary Public in and for the state of _____

FORM 4: UNCONDITIONAL WAIVER FOR FINAL PAYMENTS

PROJECT NAME: _____
OWNER'S NAME: _____ PROJECT NUMBER_____

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Project _____

Job. No. _____

The signer of this document has been paid in full for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) on the property of _____ (owner) located at _____ (location) to the following extent: _____ (job description). The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date _____
_____ (Company name)
By _____ (Signature)
_____ (Printed/Typed name)
_____ (Title)

SWORN AND SUBSCRIBED before me at _____, _____, This ____ day of _____. 20____ A.D.

_____

Notary Public in and for the state of _____

(END OF ATTACHED FORMS)

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for project record documents, including but not limited to:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.
   4. Miscellaneous record submittals.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings:
   1. Number of Copies: Submit one set of marked up record prints.
   2. Number of Copies: Submit copies of record Drawings:
      a. Initial Submittal:
         1) Submit PDF electronic files of scanned record prints and one of file prints.
         2) Submit record digital data files and one sets of plots.
         3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Final Submittal:
         1) Submit PDF electronic files of scanned record prints and three sets of prints.
         2) Submit record digital data files and three sets of record digital data file plots.
         3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and one annotated PDF electronic file of the Project Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy and one annotated PDF electronic file and directory of each submittal.
   1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked up Product Data as a component of manual.

D. Miscellaneous Record Submittals: Refer to the individual Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report monthly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 PROJECT RECORD DOCUMENT PROCEDURES

A. Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference.
   1. Do not use As Built Drawings and Specifications for Record Drawings and Specifications.

B. Recording Procedures: Update drawings and specifications on daily bases to record actual conditions. Record information concurrently with construction progress. Do not conceal Work until required information is accurately recorded.

C. Store Record Documents and samples apart from as built documents used for construction.
   1. Label and file Record Documents and samples in accordance with section number listings in Table of Contents. Label each document *PROJECT RECORD* in neat, large, printed letters.
   2. Maintain Record Documents in clean, dry and legible condition.
   3. Make Record Documents and samples available for inspection upon request of Architect.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked up paper copies of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked up record prints. Show actual installation conditions where installation varies from that shown originally.
      a. Give attention to information on concealed elements difficult to identify or measure and record later.
      b. Accurately record information in an acceptable drawing technique.
      c. Record data as soon as possible after obtaining it.
      d. Record and check the markup before enclosing concealed installations.
      e. Cross reference record prints to corresponding shop drawings or archive photographic documentation.

   2. Content: Types of items requiring marking include, but are not limited to, the following:
      a. Dimensional changes to Drawings.
      b. Revisions to details shown on Drawings.
      c. Depths of foundations below first floor.
      d. Locations and depths of underground utilities.
      e. Revisions to routing of piping and conduits.
      f. Revisions to electrical circuitry.
      g. Actual equipment locations.
      h. Duct size and routing.
      i. Locations of concealed internal utilities.
      j. Changes made by Change Order or Construction Change Directive.
      k. Changes made following Architect's written orders.
      l. Details not on the original Contract Drawings.
      m. Field records for variable and concealed conditions.
      n. Record information on the Work that is shown only schematically.

   3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked up record prints.
   4. Mark record sets with erasable, red colored pencil. Use colors to distinguish between changes for different categories of the Work at same location.
   5. Mark important additional information that was either shown schematically or omitted from original Drawings.
   6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked up record prints with Architect. When authorized, prepare full set of corrected digital data files of the Contract Drawings:
   1. Format: Same digital data software program, version, and operating system as the original Contract Drawings and annotated PDF electronic file with comment function enabled.
   2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
   3. Refer instances of uncertainty to Architect for resolution.
   4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
      a. Refer to Section 01 33 00 for requirements related to use of Architect's digital data files.
      b. Architect will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
   1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or modification.

   2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation *PROJECT RECORD DRAWING* in a prominent location.
   1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
   2. Format: Annotated PDF electronic file with comment function enabled.
   3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
   4. Identification: As follows:
      a. Project name.
      b. Date.
      c. Designation PROJECT RECORD DRAWINGS.
      d. Name of Architect.
      e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications. Indicate actual product installation where installation varies from that indicated in Specifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
   3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
   4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.

5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file and marked up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 RECORD SAMPLES

A. Record Samples: Determine with Architect and Owner which submitted Samples are to be maintained as Record Samples. Maintain and mark one set to indicate date of review and approval by Architect; note any deviations or variations between reviewed sample and installed product or material.

2.5 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by the individual Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Include the following:
1. Reviewed shop drawings, product data, and samples.
2. Field test reports.
3. Inspection certificates and manufacturer's certificates.
4. Inspections by authorities having jurisdiction (AHJ).
5. Documentation of foundation depths.
6. Special measurements or adjustments.
7. Tests and inspections.
8. Surveys.
9. Design mixes.

B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked up miscellaneous record submittals. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.
4. O&M Manuals should be uploaded into Owner’s designated software (Prolog)

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:
   a. Name of Project.
   b. Name and address of videographer.
   c. Name of Architect.
   d. Name of Contractor.
   e. Date of video recording.

2. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.

e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish an instructor to describe Owner's operational philosophy.
   2. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

   1. Schedule training with Owner through Program Manager with at least 10 days' advance

notice.

C. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

END OF SECTION 01 79 00

SECTION 02 41 00 - DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Furnishing all labor, materials, and equipment necessary for demolition, dismantling, cutting, and alterations as indicated, specified, and required for completion of the Contract, as applicable. Includes items such as the following:
      a. Salvage of building elements for reuse, return to the Owner, or sale.
      b. Building demolition excluding removal of hazardous materials and toxic substances.
      c. Selective demolition of built site elements.
      d. Selective demolition of building elements for alteration purposes.
      e. Abandonment and removal of existing utilities and utility structures.
      f. Protection of existing work to remain.

1.3 RELATED REQUIREMENTS

A. Section 00 31 00 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.

B. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.

C. Section 01 10 00 - Summary: Sequencing and staging requirements.

D. Section 01 10 00 - Summary: Description of items to be removed by Owner.

E. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.

F. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

G. Section 01 57 13 - Temporary Erosion and Sediment Control.

H. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.

I. Section 01 73 00 - Execution: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

J. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

K. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal.

L. Section 31 22 13 - Rough Grading: Topsoil removal.

M. Section 31 22 13 - Rough Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

N. Section 31 23 23 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

O. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.

P. Section 32 93 00 - Plants: Relocation of existing trees, shrubs, and other plants.

Q. Section 32 93 00 - Plants: Pruning of existing trees to remain.

1.4 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.

B. Site Plan: Showing:
   1. Vegetation to be protected.
   2. Areas for temporary construction and field offices.
   3. Areas for temporary and permanent placement of removed materials.

C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
   1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
   2. Identify demolition firm and submit qualifications.
   3. Include a summary of safety procedures.

D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.6 EXISTING CONDITIONS

A. The Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during work, notify Architect promptly for instructions. Failure to notify will make the Contractor liable for damage to these utilities arising from the Contractor's operations subsequent to discovery of such unknown active utilities.

B. Conduct demolition to minimize interference with adjacent structures or items to remain. Maintain protected egress and access at all times.

1.7 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of 5 years of documented experience.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

A. The Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during Work, notify the Architect promptly for instructions. Failure to notify will make The Contractor liable for damage to these utilities arising from the Contractor's operations subsequent to discovery of such unknown active utilities.

B. Conduct demolition to minimize interference with adjacent structures or items to remain. Maintain protected egress and access at all times.

3.2 SCOPE

A. As indicated on Drawings.

3.3 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. The Owner has first right of refusal on all salvaged items. Coordiante with the Owner prior to demolition.

B. Comply with other requirements specified in Section 01 73 00 - Execution.

C. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   5. Provide, erect, and maintain temporary barriers and security devices.
   6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   8. Do not close or obstruct roadways or sidewalks without permit.
   9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
   10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

D. Do not begin removal until receipt of notification to proceed from the Owner.

E. Do not begin removal until built elements to be salvaged or relocated have been removed.

F. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.

G. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

H. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

I. If hazardous materials are discovered during removal operations, stop work and notify the Architect and the Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
   1. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

3.4 PROTECTION

A. Adequate protection measures shall be provided to protect workmen and passers-by on and off the site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition should damage occur. Replace trees and shrubs outside building area disturbed by operations.

B. In accordance with generally accepted construction practices, Contractor shall be solely and completely responsible for working conditions at the jobsite, including safety of all persons and property during performance of the Work. This requirement shall apply continuously and shall not be limited to normal working hours.

C. Safety precautions prevent damage to existing elements identified to remain or to be salvaged and prevent injury to the public and workmen engaged onsite. Demolish roofs, walls, and other

building elements in such a manner that demolished materials fall within foundation lines of building. Do not allow demolition debris to accumulate onsite. Pull down hazardous work at end of each day; do not leave standing or hanging overnight, or over weekends:

1. Protect existing items that are not indicated to be altered. Protect utilities designated to remain from damage.
2. Protect trees, plant growth, and features designated to remain as final landscaping as indicated on Drawings.
3. Protect bench marks from damage or displacement.

D. Any construction review of the Contractor's performance conducted by the geotechnical Engineer is not intended to include review of the adequacy of Contractor's safety measures in, on, or near the construction site.

3.5 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.6 PREPARATION

A. Scheduling:
   1. General: Coordinate and schedule demolition work as required by the Owner and as necessary to facilitate construction progress.

B. Hazardous Materials:
   1. General: Identify chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations, and notify such jurisdictional agencies as may be required. Collect and legally dispose of such materials at official disposal locations away from the site.
   2. Asbestos: If asbestos or materials containing asbestos are encountered, stop work immediately and contact the Owner. Do not proceed with demolition until directed by the Owner.

C. Utility and Service Termination:
   1. Locate and identify existing utility, service, and irrigation system components affected by Work of this Contract. Review existing record Drawings, conduct site investigations, contact Underground Service Alert and other qualified cable/pipe/line locator services, and implement all other means necessary to define the location of underground systems.
   2. Prior to beginning any demolition, properly disconnect all water, gas, and electrical power supply at appropriate disconnect locations. Obtain all necessary releases and approvals from serving utility companies.
   3. Prior to demolition or disconnect, obtain the Owner’s approval that such system does not impact facilities or systems beyond the extent of this Contract.
   4. Mark location of disconnected systems. Identify and indicate stub-out locations on Project record documents.

D. Verify that existing plant life and features designated to remain are tagged or identified.
   1. The Architect will mark the features, trees, and shrubs to remain within the construction area. The Contractor shall not commence clearing and grubbing operations until authorized by the Owner and all protective measures are in place.

E. Coordinate the time and duration of all system disconnects with the Owner.

3.7 DEMOLITION

A. General Requirements:
   1. Clear areas required for access to site and execution of Work, including pavement, structures, foundations, vegetation, trash, and debris.
   2. Coordinate with the Owner the time of day and route to remove demolished materials from premises.
   3. Remove demolished materials from site as work progresses. Upon completion of work, leave areas of work in clean condition.
   4. Remove all buried debris, rubble, trash, or other material not deemed suitable by the geotechnical Engineer.
   5. Fill all voids or excavations resulting from clearing, demolition, or removal of vegetation with specified fill material.

B. Fixture and Equipment Removal:
   1. Remove existing fixtures and equipment as identified and shown on Drawings and required by the Architect.
   2. Verify all service connections to fixtures and equipment designated for removal have been properly disconnected.
   3. Remove all conductors from conduit at all abandoned circuits.

3.8 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction.
   2. Remove items indicated on Drawings.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and _____): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Refer to Section 01 10 00 - Summary for other limitations on outages and required notifications.
   4. Verify that abandoned services serve only abandoned facilities before removal.
   5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.

3. Repair adjacent construction and finishes damaged during removal work.
4. Patch as specified for patching new work.

3.9 UTILITY AND BUILDING SERVICES REMOVAL AND RE-INSTALLATION

A. Where crossing paths and potential points of interference with existing utility services are shown or can be reasonably inferred from surface conditions or evidence of subsurface systems, such as meter boxes, vaults, relief vents, cleanouts, and similar components:
   1. Review all Contract Documents showing crossing paths and potential points of interference.
   2. Pot-hole or determine by other means the accurate depth and location of such utilities.
   3. Incorporate all costs required to complete work under this Contract, including additional trenching, re-routing of existing and new utilities, and all means necessary to construct work under this Contract.
   4. No additional cost to Owner will be allowed for work necessary to accommodate utility conflicts where such crossing paths are shown on Contract Drawings or can be reasonably inferred from surface conditions or components.

B. Remove all conductors from conduit at all abandoned electrical circuits.

C. Seal off ends of all piping, drains, and other components as directed by Architect and serving utility.

D. Where necessary to maintain service to existing utility and building systems, relocate or redirect all conduit and conductors, piping, drains, and associated system components:
   1. Re-circuit all electrical as required.
   2. Re-circuit all landscape irrigation valving and control systems as required.
   3. Temporarily terminate landscape system components in approved boxes or with approved caps, suitable for re-connection or extension.
   4. Extend or otherwise modify all site drainage systems, including catch basins, drain inlets, and piping. Fine grade to maintain proper drainage flow pattern to drains.

E. Demolish structure in an orderly and careful manner:
   1. Use of explosives prohibited.

3.10 DEBRIS AND WASTE REMOVAL

A. Demolished materials become property of the Contractor and shall be removed from premises, except those items specifically listed to be retained by the Owner.

B. Remove debris, junk, and trash from site on a daily basis.

C. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal.

D. Leave site in clean condition, ready for subsequent work.

E. Clean up spillage and wind-blown debris from public and private lands.

3.11 CLEANING

A. Upon completion of work of this Section, promptly remove from the working area all scraps and debris.

B. Clean excess material from the surface of all remaining paved surfaces and utility structures.

C. Power wash all concrete surfaces to remove stains, dried mud, tire marks, and rust spots.

END OF SECTION 02 41 00

SECTION 02 41 13 - SELECTIVE DEMOLITION

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Partial demolition of existing building as required to accommodate additions and renovations as shown on the drawings or required. Include removal of existing utilities as indicated or encountered; removal of masonry, and mechanical, electrical, and plumbing items as indicated or required.

1.2 SUBMITTALS

A. Submit the following items.
   1. Itemized Demolition Schedule.
   2. Detail all demolition methods to be used.

1.3 PERMITS

A. Procure and pay for all necessary permits or certificates required to complete the work specified. Make any and all required notifications and comply with all applicable Federal, State and local ordinances.

1.4 QUALITY ASSURANCE

A. Provide at least one (1) person who shall be present and in charge of the Demolition Work at all times and who shall be thoroughly familiar with all phases of all work performed under this Section.

B. Comply with all pertinent codes and regulations applying to this work.

1.5 JOB CONDITIONS

A. Use all means necessary to prevent the spread of dust during performance of this work. Provide additional clean filters for the existing air handling system serving those areas to remain to protect them from construction dust.

B. Use all means necessary to protect the existing building to remain from all types of damage, including fire, water damage, and unnecessary interruption of utility services. In the event of damage of any kind, immediately make all repairs and replacements necessary to the approval of the Owner at no additional cost to the Owner.

C. Motor driven equipment shall have functional mufflers.

D. Visit the site and examine the existing structure. Note all conditions as to the character and extent of work involved.

1.6 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Management and Coordination

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all barricades, shoring, and bracing necessary to protect the tenants, workmen, and Public from danger. Barricades shall be sufficiently designed to protect and or exclude the public from all hazards.

B. All other materials, not specifically described but required for proper completion of Work of this Section, shall be as selected by the Contractor subject to the approval of the Owner.

C. The Owner and Architect are not responsible and make no claims for the quality or quantity of the materials being demolished. The General Contractor or subcontractors that undertake or assume the benefits of salvage efforts shall assume all risks associated with that effort.

2.2 DEMOLITION WORK

A. Perform demolition work in manner so as to allow Owner's safe use of existing facility.

B. Perform demolition work in order to maintain Owner's construction schedule.

2.3 REMOVAL OF PARTITIONS, COLUMNS AND STRUCTURE

A. Masonry walls or other sections of masonry shall not be permitted to fall on floors of building in masses to exceed safe carrying capacity of floors. Existing floors shall be properly protected with plywood on both sides of a partition to be demolished.

B. Provide temporary shoring or bracing wherever necessary for the protection of occupants, workmen, walls, partitions, roofs, floors and structure to remain.

C. Structural or load-supporting members shall not be cut or removed adjacent to existing structures to remain until all loads carried by members have been removed or adequately supported.

D. No masonry walls shall be removed until it has been determined that the walls to be removed do not support the roof. To determine this, all adjacent materials such as finish ceilings shall be removed to provide adequate views of existing structure. Provide temporary shoring as needed. The Contractor shall take all precautions necessary to ensure the safety of the demolition workers and all occupants of the building.

E. No demolition will be allowed above, below, adjacent to or near any occupied areas of the building.

F. Where access holes in existing ceilings or removal of existing ceilings are required, minimize the access in order to minimize the repair work and repair or replace removed or damaged work to match adjacent undamaged work.

G. Cut and tooth new openings in masonry where required, of correct size to permit installation of frames and anchors for new doors.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Before commencing the Work of this Section, verify with the Owner that all items to be removed by the Owner have been removed. Schedule the work in a careful manner with all necessary consideration for the Public and the Owner. All items of existing equipment and materials or any other item of value to the Owner shall be salvaged by the Owner prior to demolition.

B. All material removed under this Contract, which is not to be salvaged or reused, shall become the property of the Contractor and be promptly removed from the site. At all times use movable debris boxes, covered, to convey the material through the building. Do not store or permit debris to accumulate on the site. Dumpsters shall not overflow and shall be emptied on a regular basis. Remove all debris from the building premises and leave the construction site "Clean" each day. All debris shall be dumped in an approved disposal facility and all fees for this shall be paid by the Contractor. Contractor is responsible for completely removing all demolished materials from the site and disposing of them in accordance with all local, State and Federal Regulations. If Contractor fails to remove debris promptly, Owner reserves the right to have debris removed at Contractor’s expense.

C. Conduct operations so as not to interfere with adjacent occupied spaces, roads, streets, drives, walks, service lines and the like.

D. Keep all pedestrian areas clear for passage at all times.

3.2 PROTECTION OF STRUCTURES, PROPERTY

A. Execute demolition work to ensure adjacent property no damage from falling debris or other causes.

B. Take precautions to guard against movement, settlement, or be liable for such movement, settlement, or collapse; repair promptly such damage when so ordered.

C. Repair damage to Owner’s property or any other person or persons on or off premises by reason of required work.

END OF SECTION 02 41 13

SECTION 02 41 13.23 - ABANDONMENT OF EXISTING UTILITIES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

A. Abandon water lines, storm and sanitary sewers, manholes, and associated appurtenances as indicated on the Plans in accordance with the methods outlined herein.

1.2 PAYMENT

A. Payment will be made if an item is provided for such on the bid form; otherwise, include cost of work in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Specific products are not required. Reference other applicable sections of the specifications for material required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate all work so that existing utilities are operable until new utilities are complete and in place. Keep any service interruptions to a minimum.

3.2 WATER LINE ABANDONMENT

A. Remove at least one joint of existing pipe where crossing or tying-in with new water lines. Plug both ends of abandoned line with an appropriate manufactured fitting (cap or plug) or fill end of line with 3000 psi concrete. Backfill as per SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES.

3.3 SEWER ABANDONMENT

A. Unless noted on drawings to be removed, abandon sewers 12 inches in diameter and smaller by filling with a liquid concrete slurry composed of a 3 sack per cubic yard mix using pea gravel (1-1/2 inch and smaller aggregate) or drilling mud. Limit length of application to individual sections between manholes. Construct a temporary dam in downstream manholes above top of pipe. Pour slurry or mud in upstream manhole or in riser pipe attached to upstream end of sewer. Fill line till slurry or mud rises above top of pipe on both ends.

B. Sewers between 12” – 36” in diameter shall be abandoned in accordance with either 3.3.A or 3.3.C.

C. Unless noted on drawings to be removed, abandon sewers 36 inches in diameter and larger by breaking in top of pipe and backfilling. Excavate and expose top half of existing sewer. Using appropriate equipment, cave-in the top half of pipe; as a minimum, the upper 120-degree section of pipe must be broken in. Fill open pipe with backfill material and compact to top of existing pipe. Backfill to grade in accordance with SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND

UTILITIES.

3.4 MANHOLE ABANDONMENT

A. After abandoning sewer lines in the appropriate manner, fill manholes to be abandoned with bank sand. Excavate around top of manhole and remove manway (reducer) section of manhole. Fill manhole with bank sand in 12-inch compacted lifts to top of manhole barrel. Backfill to finished grade in accordance with SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES.

END OF SECTION 02 41 13.23

SECTION 03 05 80 - UNDER-SLAB VAPOR RETARDER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Products Supplied Under This Section
   1. Vapor Retarder, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.

B. Related Sections
   1. Section 03 30 00 Cast-in-place Structural Concrete
   2. Section 01 45 23 Structural Testing and Inspection

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. ASTM E 1745-97 (2004) Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
   2. ASTM E 154-88 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
   3. ASTM E 96-95 Standard Test Methods for Water Vapor Transmission of Materials
   4. ASTM E 1643-98 (2005) Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

B. American Concrete Institute (ACI)
   1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.4 SUBMITTALS

A. Quality Control / Assurance
   1. Full set of test results as per paragraph 8.3 of ASTM E 1745.
   2. Manufacturer’s samples, literature
   3. Manufacturer’s installation instructions for placement, seaming and pipe boot installation.

1.5 SUBSTITUTIONS

A. Product Review
   1. Request must be made 14 days prior to bid date to allow time for proper review. Reviews will be at contractor’s expense.
   2. Independent laboratory test results showing compliance with ASTM E 1745 Class A, a permeance less than 0.01 Perms (grains/(ft2 *hr * in. Hg) before and after the mandatory

conditioning tests ASTM E 154 Sections 8,11,12, and 13. (Woven, and recycled plastics are not permitted

3. Incomplete substitutions will not be accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Vapor Retarder (Performance based specification). When the specifications of different sections conflict, the contractor shall perform to the most restrictive provision. Vapor Retarder membrane must have the following properties.
   1. Permeance as tested after mandatory conditioning (ASTM E 154 sections 8,11,12,13) less than 0.01 Perms [grains/(ft2 *hr. * in. Hg)]
   2. Other performance criteria
      a. Strength: ASTM E 1745 Class A
      b. Thickness: 15 mils minimum

2.2 ACCESSORIES

A. Seam Tape
   1. Tape must have the following qualities:
      a. Water Vapor Transmission Rate ASTM E 96, 0.3 perms or lower
   2. Seam Tape
      a. Manufacturer’s standard seam tape.
      b. Stego Crete Claw (for slabs on void boxes).

B. Vapor Proofing Mastic
   1. Mastic must have the following qualities:
      a. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower

C. Pipe Boots
   1. Construct pipe boots from vapor retarder material, pressure sensitive tape and/or mastic per manufacturer’s instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ensure that subsoil is approved by architect or geotechnical firm
   1. Level and tamp or roll aggregate, sand, or tamped earth base.

3.2 INSTALLATION

A. Install Vapor Retarder:
   1. Installation shall be in accordance with manufacturer’s written instructions and ASTM E 1643-09.
      a. Unroll Vapor Retarder with the longest dimension parallel with the direction of the pour.
      b. Lap Vapor Retarder over footings or seal to foundation walls.
      c. Overlap joints 6 inches and seal with manufacturer’s tape.

d. Seal all penetrations (including pipes) per manufacturer's instructions.
e. No penetration of the Vapor Retarder is allowed except for reinforcing steel and permanent utilities.
f. Repair damaged areas by cutting patches of Vapor Retarder, overlapping damaged area 6 inches, and taping all four sides with tape.

END OF SECTION 03 05 80

1.1 SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 2 - GENERAL

2.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2.2 SUMMARY

A. Section includes cast-in-place concrete formwork, for the following:
   1. Footings and/or piers.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Suspended slabs.
   5. Concrete toppings.
   6. Building frame members.
   7. Building walls.

B. Related Sections:
   1. Section 01 45 23 “Testing and Inspection Services”.
   2. Section 03 33 00 "Architectural Concrete".
   3. Section 03 30 00 “Cast In Place Concrete”.
   4. Section 03 20 00 “Concrete Reinforcing”.
   5. Section 03 47 13 “Tilt Up Concrete”.
   6. Section 03 38 16 “Unbonded Post Tensioned Concrete”.
   7. Section 03 53 00 "Concrete Topping".

2.3 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.

2.4 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.

2.5 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.

2.6 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.

2.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician. An experienced installer who has completed work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

B. Testing Agency Qualifications: Refer to Section 01 45 23.

C. Layout and measurement of concrete forms and embedment's, required for work, performed by a licensed surveyor employed by the contractor.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete."
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.

PART 3 - PRODUCTS

3.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Permanent Metal Forms for Slabs: Deck material, gauge and rib pattern shall be as noted on Drawings.

E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
   1. Pans shall be free of dents, irregularities, sag, rust or other deterioration.
   2. In areas permanently exposed to view, provide one piece units, manufactured to length between beams or ribs, or segmented units with reinforced butt-joint splices.

F. Load-bearing Rigid Board Insulating Fill Under Slabs:
   1. Extruded Polystyrene Board Insulation: Comply with ASTM C 578, Type X, 15 psi minimum compressive strength, 1.30 lb./cu. ft. (21 kg/cu. m) .

a. Owens Corning Insulating Systems, LLC, Toledo, OH 43659; www.owenscorning.com.
b. Thermal Resistance: (180-day real-time aging as mandated by ASTM C578, measured per ASTM C 518 at mean temperature of 75F): R-5.0 per inch of thickness, with 90% lifetime limited warranty on thermal resistance.
c. Blowing Agent Formulation: Zero ozone depleting.
d. Install according to manufacturer's recommended instructions.

2. Expanded Polystyrene Board Insulation: Un-faced Flat Board Stock: Rigid, closed cell, expanded polystyrene (EPS) boards, UL certified, complying with ASTM C 578 Type VIII, 15 psi minimum compressive strength .
a. Insulfoam, a Carlisle Company, which is located at: 6004 N. Westgate Blvd. Suite 120 ; Tacoma, WA 98406; Toll Free Tel: 800-248-5995; Tel: 253-572-5111; Email: request info (info@insulfoam.com); Web: www.insulfoam.com
b. Blowing Agent Formulation: Zero ozone depleting.
c. Install according to manufacturer's recommended instructions.

G. Formwork Accessories
1. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
2. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
3. Expansion-Contraction Joint Filler Material: Bonded fabric of thickness indicated on Drawings composed of cellular fibers securely bonded together and uniformly saturated with asphalt complying with ASTM D 1751.
4. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
a. Formulate form-release agent with rust inhibitor for steel form-facing materials.
5. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
a. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
b. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
c. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

PART 4 - EXECUTION

4.1 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.

4.2 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.

4.3 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.

4.4 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.

4.5 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.

4.6 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.

4.7 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.

4.8 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 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 restraightening 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.

4.9 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment

END OF SECTION 03 10 00

SECTION 03 10 01 – SPREAD FOOTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract, Division 1 - General Requirements, and Drawings apply to Work of this Section.

1.02 RELATED WORK

A. Section 01410: Quality Control

B. Section 03300: Concrete

1.03 UNIT PRICE

A. Elevations given are for bidding/estimating purposes only. Should field conditions require footings to be deeper or shallower, adjustment in Contract shall be made on a unit price basis.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Retarding Admixture: ASTM C494, Type B.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Establish bottoms of footings in stratum as indicated on Drawings. Elevations given are for bidding/estimating purposes only.

B. Totally excavate soils encountered to size, depths, and elevations indicated on Drawings as necessary for construction of Work, including space for forms, bracing and shoring, waterproofing, and inspection.

C. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods, as required to prevent cave-ins or loose dirt from falling into excavations.

D. Grade around excavation to prevent surface water runoff into excavated area.

E. Excavate bottom of footing level with 1/24 maximum slope.

F. Protect bottom of excavations and soil around and beneath foundations from frost. Do not place concrete on frozen soil.

G. Notify Architect of unexpected subsurface conditions and discontinue Work in area until Architect provides notification to resume Work.

H. Drilling of spread footings:

1. As indicated on Drawings, drill footings in true alignment at locations as indicated on Drawings with maximum lateral variation not exceeding lesser of 3 inches or 4% of diameter.

2. Drill footing plumb. Deviation more than lesser of 10% of diameter or 1% of full height, from vertical, will be cause for rejection.

3. Drill footing using rotary rigs through overburden into bearing material as indicated on Drawings. Take top of bearing material at elevation as indicated on Drawings. Elevation is set for estimating purposes only and is not to be construed as elevation of top of bearing material throughout site. Actual elevation shall be verified by Geotechnical Consultant in field.

3.02 BEARING STRATA

A. On-site inspection of foundation bearing strata shall be conducted during construction by Geotechnical Consultant.

B. Soft areas of bearing strata or areas otherwise disturbed shall be repaired in accordance with recommendations of Geotechnical Consultant.

3.03 WATER REMOVAL

A. Prior to concrete placement, remove all water from bottom of excavation.

3.04 PLACING OF FOOTING REINFORCEMENT

A. Clean reinforcement of foreign materials which will destroy or reduce bond with concrete.

B. Install reinforcement indicated on Drawings as follows:

1. Support cage off bottom of excavation distance indicated on Drawings.

2. Firmly secure cage in place, free of contact with sides of excavation, distance indicated on Drawings.

C. Provide dowels or anchor bolts in footings as indicated on Drawings.

3.05 CONCRETE PLACEMENT

A. Place concrete immediately after excavation has been inspected and bearing strata found acceptable by Geotechnical Engineer.

B. Place concrete in footing by free fall, hopper, or tremie, as needed to prevent segregation or striking side of excavation or reinforcement.

C. Place concrete continuously without construction joints for full depth of footing.

D. Vibrate concrete for full depth of footing.

E. During placement of concrete, and until concrete has set, provide protection around top of excavation to prevent entry of soil or other foreign matter.

F. Placement should be controlled by qualified personnel through continuous observation.

3.06 FIELD QUALITY CONTROL

A. Geotechnical Consultant shall provide qualified personnel at site to inspect footings as follows:

1. Before reinforcement and concrete is placed, inspect each footing as follows:

a. Inspect excavations to ensure seating in bearing strata which produces foundation capacities indicated on Drawings.
b. Inspect excavations to ensure that they are properly cleaned and dried.
c. Inspect dimensions of footing for conformance to Drawings, both size and location. Contractor is responsible for providing to Geotechnical Consultant, site elevations and top of footing center alignment survey.

2. Inspect reinforcement as follows:

a. Prior to placement, inspect reinforcement for grade, quality of material, absence of foreign matter, and for suitable storage.

b. Provide continuous inspection of reinforcement during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, clearances, form tolerance, security of support and ties, and absence of foreign matter on reinforcement.

B. Geotechnical Consultant shall submit inspection reports to Architect for each footing. Report shall include:

1. Elevation of top of bearing strata.

2. Size of footing (or diameter and thickness).

3. Statement describing whether or not footing reinforcement and reinforcement placement conformed to Drawings.

4. Statement evaluating that footing seated in indicated bearing strata will produce foundation capacities indicated on Drawings.

END OF SECTION 02 03 80

SECTION 03 11 00 - CONCRETE FORMWORK

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. Work Included: Perform all work necessary and required for the construction of the project as indicated. Such work includes but is not necessarily limited to the furnishing and installing of forms for all cast-in-place concrete work as shown and noted on the drawings and specified herein, including the removal of forms at completion of concrete work.

B. Related Work in Other Sections: The following items of associated work are included in other sections of these specifications:
   1. Excavating, filling, backfilling, and other earthwork operations.
   2. Furnishing and placing of reinforcing steel.
   3. Cast-in-place concrete.
   4. Filling of tie rod, bolt holes, and defects. Curing of concrete.
   5. Furnishing of dovetail anchor slots for masonry adjacent to concrete.
   6. Furnishing of anchor bolts and miscellaneous metal items to be embedded in concrete.
   7. All other carpentry work.
   8. Furnishing of sheet metal reglets to be embedded in concrete.

1.2 CODES AND STANDARDS

A. The American Concrete Institute's "Recommended Practice for Concrete Formwork", ACI 347, and Chapter 4, ACI 301 are hereby made a direct part of this specification, and all concrete formwork included in this contract shall conform with the applicable requirements therein except as specified otherwise herein.

1.3 SHOP DRAWINGS

A. For exposed concrete submit fabricating drawings of forms showing the jointing of facing panels, the location of form ties, and any necessary alignment bracing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms for exposed concrete at exterior of building: Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces (this includes all surfaces to receive a painted finished coat) with plywood, metal-framed plywood-faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

B. Forms for exposed concrete at interior of building: Form concrete surfaces with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit. Use either 6" or 8" wide lumber, nominal 1" thickness, or plywood as specified for exterior exposed concrete, at Contractor's option. Use "BB FIR" or "MDO" grade plywood for underside of parking decks.

C. Form Ties and Spreaders: Standard metal form clamp assembly, of type acting as spreaders and leaving no metal within one inch (1") of concrete face. Inner tie rod shall be left in concrete when forms are removed. No wire ties or wood spreaders will be permitted.

D. Form Anchors and Hangers: Anchors and hangers used for exposed concrete shall not leave exposed metal at surface. Hangers supporting forms from structural steel shall be symmetrically arranged on supporting members to minimize twisting or rotation of member. Penetration of structural steel members will not be permitted.

E. Form Coatings: Form coating shall be a polymeric material and shall contain no wax or oil.

PART 3 - EXECUTION

3.1 CONSTRUCTION OF WORK

A. The design layout, construction and removal of formwork shall be the sole responsibility of the Contractor.

B. Earth Forms: If conditions warrant, and the approval of the Engineer is secured, earth trench forms for footings will be allowed. Where footings are placed on dry soil or pervious material, waterproof paper shall be laid over the earth surfaces to receive concrete. Soil may be thoroughly wetted to optimum moisture content prior to placing concrete in lieu of using waterproof paper.

C. Formwork-General: Forms shall be constructed of sound material, shall be of the correct shape and dimensions, mortar tight, of sufficient strength, and so braced and tied together that the movement of men, equipment, materials, or placing and vibrating the concrete will not throw them out of line or position. Before reusing forms, or when using second-hand lumber for forms, same shall be cleaned and all nails removed therefrom. Forms shall be strong enough to maintain their exact shape under all imposed loads. Camber where necessary to assure level finished soffits. Forms shall be so constructed that they may be easily removed without damage to the concrete. Before concrete is placed in form, the horizontal and vertical position of the form shall be carefully verified, and all inaccuracies corrected. All welding and bracing shall be completed in advance of placing of concrete.

D. Forms for Exterior Exposed Concrete (concrete to receive paint): Plywood panels shall be clean, smooth, uniform in size, and free from damaged edges and holes. Full size panels shall be used wherever possible. After construction, tape joints of plywood panels to prevent joint protrusions in concrete. Horizontal joints must be level and continuous. All edges of plywood must be backed to prevent separation. Use special care in the forming and stripping of the forms to protect the corners. Form inside corners with mitered boards so that no concrete is placed against form ends.

E. Framing and Bracing: Framing, bracing, supporting members, and centering shall be of ample size and strength to safely carry, without deflection, all dead and live loads to which forms may be subjected, and shall be spaced sufficiently close to prevent any bulging or sagging of forms. Concrete out of line, level, or plumb will be cause for rejection of the whole work affected. Distribute bracing loads over base area on which bracing is erected. When placed on ground, protect against undermining or settlement.

F. Tolerances:
1. Variation from plumb in lines and surfaces of walls and arises shall not exceed 1/8 inch in 10 feet with maximum "in" and "out" variation occurring in not less than 20 feet.
2. Variation in linear building lines from established position of columns, piers, or walls shall not exceed 1/4 inch in any bay of 20 feet or 1/2 inch in 40 feet or greater length.
3. Variation in thickness of slabs and walls shall not exceed minus 1/4 inch or plus 1/2 inch.
4. Variation from the level or from the grades indicated on the drawings:
    a. In slab soffits, ceilings, and in arises

In 10 feet.....…….....1/4 inch.
In any bay or 20 feet max.....3/8 inch.
In 40 feet or more.....…….....3/4 inch.

b. For exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines.

In any bay or 20 feet max.....1/4 inch.
In 40 feet or more…….....1/2 inch.

5. Variation from level in floors or from the grade indicated: In any 10 feet.....1/4 inch.
6. Size and location of sleeves, pits, floor openings, etc., the location of bolts, inserts and fastenings: Plus or minus 1/4 inch.
7. Footings:
   a. Variation in dimensions in plan:
      minus.....1/2 inch, plus.....2 inch.

   b. Misplacement or eccentricity: Two percent of the footing width in the direction of misplacement but not more than 2 inches. These tolerances for footings apply to the concrete only, and not to reinforcing bars or dowels.

G. Chamfered Corners: As indicated, provide moldings in forms for all chamfering required. Moldings shall be 45-degree right triangle in profile of size required, milled from wood free from open defects.

H. Form Ties: Form ties shall be of sufficient strength and used in sufficient quantities to prevent spreading of the forms. Ties shall be placed at least one inch away from the finished surface of the concrete. The use of ties consisting of twisted wire loops will not be permitted. Inner rods shall be left in concrete when forms are stripped. All form ties shall be spaced equidistant, and symmetrical, and shall line up both vertically and horizontally.

I. Cleanouts and Access Panels: Provide removable cleanout sections or access panels at the bottom of all forms to permit inspection and effective cleaning of loose dirt, debris, and waste material. All forms and surfaces to receive concrete shall be cleaned of all chips, sawdust, and other debris and shall be thoroughly blown out with compressed air just before concrete is placed.

J. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

K. Construction Joints: Construction joints shall be formed as specified in Section intitled "Cast-In-Place Concrete." Provide a surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints. Just prior to subsequent pour, remove strip and tighten forms to conceal shrinkage. Construction joints shall show no "overlapping" of concrete and shall, as closely as possible, present the same appearance as butted plywood joints. Joints in a continuous line shall be straight, true, and sharp.

L. Embedded Items: Provisions shall be made for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, and other features. No wood other than necessary nailing blocks shall be embedded in concrete. Complete cooperation shall be extended suppliers of embedded items in their installation. Secure information for embedded items from other trades as required. All embedded items shall be securely anchored in correct location and alignment prior to placing concrete, electrical and telephone conduits shall be run in concrete only upon the written approval of the Engineer. Under NO circumstances will ALUMINUM CONDUIT be permitted in concrete. No conduit larger than 3/4 inch in diameter and no plumbing pipes of any size will be permitted in concrete walls, columns, or slabs.

M. Opening for Items Passing Through Concrete: Frame openings in concrete where indicated on architectural, structural, plumbing, mechanical, or electrical drawings. Contractor shall establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections. Contractor shall be held responsible for proper coordination of all work of this nature in order that there will be no unnecessary cutting and patching of concrete. Any cutting and repairing to concrete required as a result of failure to provide for such openings shall be paid for by the Contractor at no additional expense to the Owner.

N. Screed: Contractor shall set screeds and establish levels for tops of concrete slabs and leveling for finish on slabs. Shape slabs to drain where required or as indicated on drawings. Before depositing concrete, all debris shall be removed from the space to be occupied by the concrete, and forms shall be thoroughly wetted. Reinforcement and inserts shall be secured in position. Free-standing water shall be removed.

O. Screed Supports: Screed supports for concrete over waterproof membranes and/or vapor-barrier membranes shall be of a cradles, pad, or base type which will not puncture the membrane. Staking through the membrane will not be permitted.

P. Shores and False Work: Contractor shall be fully responsible for the proper strength, safety, and adequacy of all falsework, supports, posts, footing, etc., used on and in connection with work. Falsework and supports shall be adequate in size and strength to resist the loads imposed upon them without deformation, deflection, or settlement. Wedges in pairs or jacks shall be used where required to bring forms, shoring, or falsework for beams, girders, slabs, and other parts of the structure to the exact elevations and uniform bearing before placing concrete. Single wedges will not be permitted. Vertical and lateral loads shall be carried to ground by form-work system or by completed structure, after it has attained adequate strength. Submit manufacturer's data for patented shores, shore splicing, and methods of shore support.

Q. Reuse and Coating of Forms: Thoroughly clean forms and recoat with specified form coating before each reuse. Do not reuse any form for exposed work which cannot be reconditioned to "like new" condition. Apply form coating to all forms in accordance with the manufacturer's specifications. Apply form coatings before placing reinforcing steel.

R. Inspection: Prior to placing of any concrete, and after placement of reinforcing steel in the forms, Contractor shall notify the Engineer so that proper inspection may be made. Such notification shall be made at least 72 hours in advance of placing concrete to permit proper arrangements to be made for inspection.

S. Rejection of Defective Work Due to Improper Forms: Any movement or bellying of forms during construction or variations in excess of the tolerances specified will be considered just cause for the removal of such forms and, in addition, the concrete work so affected. Reconstruction of forms and new concrete shall be furnished at no additional cost to the Owner.

3.2 REMOVAL OF FORMS AND SHORES

A. The supporting forms and shoring shall not be removed until the members have acquired sufficient strength to support their weight and the loads superimposed thereon safely. The contractor will be responsible for obtaining competent personnel to determine not only the method of forming, but the sequence of removal to assure that this requirement is met. All form work shall be removed without damage to the concrete.

B. The Contractor shall be guided in the removal of forms by ACI publication 347. The removal of forms and shoring shall be determined by the method of forming and supports. The removal of forms and shoring must be related to the strength of concrete as determined by tests of job-cured specimens in accordance with procedures outlined in ACI 347 and ACI 301 and test cylinders prepared in accordance with ASTM C31 with compression tests performed in accordance with

ASTM C39.

C. Shoring shall be adequate in strength and shall be so designed and placed that the load from successive parts of the structure will be transmitted directly through the falsework without creating bending or shearing stresses in the concrete. Do not remove shores until supporting members have attained sufficient strength to carry the imposed loads.

D. During the period that forms are in place on the concrete work, said forms shall always be kept wet.

E. In removing plywood forms, no metal pinch bars shall be used, and special care shall be taken in stripping. Start at top edge or vertical corner where it is possible to insert wooden wedges. Wedging shall be done gradually and shall be accompanied by light tapping on plywood panels to crack them loose. Do not remove forms with a single jerk after it has been started at one end.

F. Forms shall be left in place as long as possible to permit shrinkage away from concrete, and plywood forms shall be left in place until all other forms around are stripped and until there is no danger of damaging the concrete due to other work in the vicinity.

G. Nothing herein shall be construed as relieving the Contractor of any responsibility for the safety of the structure.

H. After stripping, Contractor shall properly protect all concrete from damage.

END OF SECTION 03 11 00

SECTION 03 11 31 - VOID FORMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes corrugated paper void form material to create a temporary support for the placement of structural concrete slabs, grade beams, or walls over expansive soils.

B. Related Sections:
1. Section 01 45 23 “Testing and Inspection Services”.
2. Section 03 33 00 "Architectural Concrete".
3. Section 03 30 00 “Cast In Place Concrete”.
4. Section 03 20 00 “Concrete Reinforcing”.
5. Section 03 47 13 “Tilt Up Concrete”.
6. Section 03 38 16 “Unbonded Post Tensioned Concrete”.

1.3 PERFORMANCE REQUIREMENTS

A. All components of the formwork shall be designed to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated including manufacturer’s written installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver form materials in manufacturer’s packaging with installation instructions.

B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.6 QUALITY ASSURANCE

A. Design, place, and maintain void forms or carton forms for cast in place concrete work in compliance with ACI 347 “Guide to Form Work” unless otherwise shown or specified.

B. Testing Agency Qualifications: Refer Section 01 45 23.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads, but not less than 800 pounds per square foot. Interior components shall be constructs as shown below:
   1. Extra Fast Decomposition – Non wax impregnated, plain kraft paper and a water soluble adhesive.
   2. Fast Decomposition – Non wax impregnated, plain kraft paper and a moisture resistant adhesive.
   3. Moderate Decomposition – Plain kraft paper with a wax impregnated medium, but non wax impregnated liners and a moisture resistant adhesive.
   4. Slow Decomposition – Plain kraft paper with wax impregnated medium / liners and a moisture resistant adhesive.
   5. Extra Slow Decomposition – Wet strength paper with wax impregnated medium / liners and a moisture resistant adhesive.

2.2 VOID BOXES

A. Slabs: Use “Slab Void” with interior cell sizes 8”x8” or smaller, capable of sustaining a working load 800 psf, for slabs 8 inches thick or less. For slabs between 8 inches thick and 12 inches thick, void box shall be capable of sustaining a working load of 1000 psf. For slabs greater than 12 inches thick, consult with the structural engineer. For interior piers, provide pre-manufactured curved end units against top of piers for tight fit.

B. Grade beams and walls: Rectangular shape as shown on plans. Trapezoidal void boxes are not acceptable. Provide end caps at ends of forms and corners. Provide pre-manufactured curved end units against top of piers for tight fit. Cartons shall be capable of sustaining a working load of 200 psf times the height of the pour (in feet), without significant deformation.

C. Design and maintain void forms to maintain all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. This includes, but is not limited to, live load, dead load, and weight of moving equipment, height of concrete drop, vibrator frequency, ambient temperature, soil pressures, and lateral stability.

D. Form material shall be designed to lose it strength upon prolonged contact with the moisture that normally accumulates beneath slabs and beams on grade. Sufficient deterioration to cushion uplift forces shall take place within a maximum of 8 weeks after placement of concrete.

2.3 RELATED PRODUCTS

A. Protection Board: Used over carton forms under slabs and under grade beam or walls wider than 12 inches. 1/4-inch minimum hardboard.

B. Soil Retainers: High density, polyethylene (HDPE). “Sure Retainer” by Motzblock or ½ inch thick “Backfill Retainer” by Sure Void Products. Retainers shall be sized such that they extend a minimum of 4 inches above the void box and 4 inches below the void box.

PART 3 - EXECUTION

3.1 CARTON FORMS

A. A void shall be constructed below all structural elements supported by piers to separate these elements from the soil. Where carton forms are used to construct this void the construction shall comply with the following:
   1. Seal discontinuous ends of carton forms and tape all joints with waterproof tape so that concrete will not enter the void space during placement of concrete. Do not leave gaps between carton form sections.
   2. Pre-manufactured carton forms with circular edges shall be used around all drilled piers. Cutting of square carton forms is not acceptable.
   3. Do not allow any portion of carton forms to fall within the circumference of piers causing reduction in bearing area.
   4. Protect carton forms from water. Do not install carton forms during wet weather or on wet ground. Carton forms which become wet prior to placement of concrete shall be removed and replaced.
   5. Protect carton forms, from puncturing, collapsing, or crushing during construction. All damaged carton forms must be replaced prior to concrete placement.
   6. Exercise care in placement of concrete to avoid collapse of carton forms. If carton forms collapse, soil beneath the concrete shall be dug out and a proper void space shall be created and protected by installing the specified soil retainers.
   7. Carton forms wrapped in plastic to protect them from water, shall have the plastic ripped or punctured immediately prior to concrete placement.

B. Carton Forms Under Slabs
   1. Carton forms under slabs shall be protected on top by a protection board as specified with the specified vapor retarder on top of the protection board.
   2. Carton forms shall not be placed under soil supported slabs on grade.

END OF SECTION 03 11 31

SECTION 03 15 00 - CONCRETE ACCESSORIES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 WORK INCLUDED

A. The Work under this Section includes all material, labor, equipment and supervision to install anchor bolts, to install formwork and reinforcing steel for cast-in-place concrete and to epoxy coat exposed reinforcement as shown on the Drawings.

1.3 RELATED WORK

A. The following work is related to this Section:

Demolition Section 02 41 16
Cast-in-Place Concrete Section 03 30 00

1.4 QUALITY ASSURANCE

A. Materials and installed work may be reviewed by the Engineer at any time during the progress of the Work.

1.5 SUBMITTALS

A. Contractor shall submit to the Engineer copies of the Manufacturers Specs. Data Sheets and Health and Safety Data Sheets for the following:

Reinforcement
Form Coating
Anchor Bolt Fastening System
Epoxy Coating
Permanent Compressible Joint Filler
Expansion Joint Assembly

1.6 DELIVERY, STORAGE AND HANDLING

A. Store all materials clear of ground, protected, so as to preclude damage.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Concrete Surfaces: APA exterior plyform BB or metal forms. Forms shall be clean and straight with mortar tight joints.

B. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces to be cured with water or curing compound. Form oil shall be similar to that manufactured by Nox-Crete Company.

2.2 ANCHOR BOLT FASTENING SYSTEM

A. Provide sizes indicated on the Drawings.

Provide one of the following embedded anchor systems:
1. "HILTI HIT Fastening System" By HILTI, Inc. Fastening Systems.
2. "HILTI HVA Adhesive Anchors" By HILTI, Inc. Fastening Systems.
3. "Molly Parabond Capsule Anchors" By Molly Fastener Group.
4. or Approved Equivalent.

2.3 REINFORCING MATERIALS

A. Reinforcing Bars: ANSI/ASTM A615, grade 60 unless noted.

B. Field Applied Epoxy Coating Materials for Existing Steel Reinforcement and Embedded Items.

C. Provide one of the following epoxy coatings for existing steel reinforcement and miscellaneous metals that are to be embedded in concrete:
1. "Sikagard 62 with Tan, Grey, Yellow or Green Pigment" by Sika Chemical Corp., Lyndhurst, N.J.
2. or Approved Equivalent.

2.4 PERMANENT COMPRESSIBLE JOINT FILLER

A. Joint filler in grout pockets and joints - as indicated on the Drawings. Acceptable products are:
1. "Flexcell" by Celotex Corporation
2. "Sonoflex F" by Sonneborn Building Products, Minneapolis, MN
3. "Ceramar Flexible Foam E. J. Filler" by W.R. Meadows, Elgin, IL.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design: The design, engineering and proper construction of the formwork shall be the responsibility of the Contractor. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces, the structure and adjacent materials. Formwork shall be braced properly to prevent displacement under vibration or sagging between supports.

B. Edge Forms and Screed Strips for Overlay: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed compacting type screeds.

C. Preparation of Form Surfaces: Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

D. Removal of Forms: Concrete formwork shall not be disturbed until the concrete has hardened to be able to support its own weight.

E. Re-Use of Forms: Clean and repair surfaces of forms to be re-used in Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
   1. Do not use "patched" forms for exposed concrete surfaces.

F. Tolerances: Comply with tolerances for formed surfaces as defined in ACI 301, Chapter 4, except as herein modified.

3.2 ANCHOR BOLT FASTENING SYSTEM

A. Install anchor bolts according to manufacturer’s recommendations.

3.3 EPOXY COATING FOR EXISTING REINFORCEMENT

A. Preparation: Existing reinforcing and miscellaneous metal to remain shall be cleaned of rust and latency to Near White Metal.

B. Installation: Existing reinforcing and miscellaneous metals that are to be embedded in concrete shall be epoxy coated in accordance with manufactures recommendations. Epoxy shall be cured prior to concrete placement.

3.4 SUPPLEMENTAL REINFORCEMENT

A. Placing Reinforcement: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
   1. Clean reinforcement of loose rust and mill scale, oil, earth and other materials which reduce bond with concrete.
   2. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations.
   3. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

B. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.

END OF SECTION 03 15 00

SECTION 03 15 13 - WATERSTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Provision of waterstops embedded in concrete and spanning control, expansion, and/or construction joints to create a continuous diaphragm to prevent fluid migration.

B. Non-metallic waterstops for use in concrete joints subjected to chlorinated water, sea water, and many waterborne chemicals.

C. Non-metallic waterstops for use in concrete joints subjected to acids, bases, alcohols, oils, solvents, or other chemicals.

1.3 REFERENCES

A. PVC WATERSTOP
   1. Corps of Engineers: CRD-C 572-74
   2. American Society for Testing Materials (ASTM)
   3. Bureau of Reclamation: C-902
   4. Canadian General Standards Board: 41-GP-35M Types 1 & 3
   5. ACI 350.2: Concrete Structures for Containment of Hazardous Materials

B. HYDROPHILIC WATERSTOP
   1. American Society for Testing Materials (ASTM)

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store waterstops under tarps to protect from oil, dirt, sunlight, and premature exposure to water.

1.5 SUBMITTALS

A. Submit shop drawings and fabrication drawings indicating placement of waterstops and shop fabrications.

B. Submit manufacturer’s test data for chemical resistance.

PART 2 - PRODUCTS

2.1 PVC WATERSTOPS FOR EXPANSION JOINTS

A. Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Greenstreak or approved equal.

B. The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.

C. Profile: Ribbed with center bulb.

D. Dimensions: 6 inches by 3/8 inch thick.

E. Performance Requirements as follows:

Property	**Test Method**	**Required Limits**
Water absorption	ASTM D 570	0.15% max
Tear Resistance	ASTM D 624	200 lb/in (35 kN/m) min.
Ultimate Elongation	ASTM D 638	350% min.
Tensile Strength	ASTM D 638	2000 psi min.
Low Temperature Brittleness	ASTM D 746	No Failure @ -35o F
Stiffness in Flexure	ASTM D 747	600 psi min.
Specific Gravity	ASTM D 792	1.45 max.
Hardness, Shore A	ASTM D 2240	79 +3
Tensile Strength after accelerated extraction	CRD-C 572	1850 psi min.
Elongation after accelerated extraction	CRD-C 572	300% min.
Effect of Alkalis after 7 days: Weight Change Hardness Change	CRD-C 572	 between -0.10% / +0.25% +/- 5 points

2.2 CHEMICALLY RESISTANT FLEXIBLE WATERSTOP

A. Thermoplastic elastomeric rubber waterstops resistant to oil, solvents, and chemicals as manufactured by Westec or approved equal.

B. Chemical resistance testing to be performed by independent ASTM certified laboratory.

C. Profile: Ribbed with center bulb

D. Dimensions: 6 inches by 3/8 inch thick.

E. Performance requirements as follows:

Property	**Test Method**	**Unexposed Value**
Tensile Strength	ASTM D638	2000 psi
Ultimate Elongation	ASTM D638	450%
100% Modulus	ASTM D638	1000 psi
Shore A Hardness	ASTM D2240	85 units
Low Temp Brittleness	ASTM D746	No Failure @ -70 F

F. Waterstop material should show less than +/- 30% change in material properties, including weight gain after 7-day exposure to selected chemicals, per ASTM D 471 testing.

2.3 HYDROPHILIC WATERSTOP FOR NON-MOVING CONTRACTION AND CONSTRUCTION JOINTS

A. Provide hydrophilic rubber waterstop as supplied by Greenstreak, HYDROTITE profile style number (fill in profile style number).

B. The waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.

C. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.

D. Performance Requirements as follows:

Chloroprene Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	1300 PSI min.
Ultimate Elongation	ASTM D 412	400% min.
Hardness (Shore A)	ASTM D 2240	50 +/- 5
Tear Resistance	ASTM D 624	100 lb/inch min.

Modified Chloroprene (Hydrophilic) Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	350 PSI min.
Ultimate Elongation	ASTM D 412	600% min.
Hardness (Shore A)	ASTM D 2240	52 +/- 5
Tear Resistance	ASTM D 624	50 lb/inch
Expansion Ratio	Volumetric Change - Distilled Water @ 70o F	3 to 1 min.

2.4 ACCESSORIES

A. PVC and Chemically Resistant Waterstops
1. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field.
2. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.
3. Provide Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.
4. Splices to be free from defects.

B. Hydrophilic Waterstops
1. Provide Greenstreak 7300 two component epoxy gel to secure HYDROTITE to rough, wet (or dry) concrete.

2. Provide LEAKMASTER single component hydrophilic sealant to secure HYDROTITE to rough, dry concrete.
3. Provide cyanacrylate adhesive (super glue) for all splices.
4. Provide LEAKMASTER as addition to cyanacrylate adhesive at all splices for added insurance (Optional).

PART 3 - EXECUTION

3.1 INSTALLATION

A. PVC and Chemically Resistant Waterstops
1. Field butt splices shall be heat fused welded using a Teflon covered thermostatically controlled waterstop splicing iron at approximately 380 degrees F. Follow approved manufacturer recommendations.
2. Lapping of waterstop, use of adhesives, or solvents shall not be allowed.
3. Center waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12” on centers along the length of the waterstop and wire tie to adjacent reinforcing steel.
4. Install in longest lengths practicable.
5. Ensure steel reinforcing bars do not interfere with proper position of waterstop.
6. Clean concrete joints of dirt and construction debris prior to second pour of concrete.
7. Cut waterstop ends with miter guide and circular saw to ensure good, full contact at joints.
8. At expansion joints, keep center bulb unembedded at joint centerline.

B. Hydrophilic Waterstop
1. Cut coil ends square (or at proper angle for mitered corners) with shears or sharp blade to fit splices together without overlaps.
2. Splices shall be sealed using cyanoacrylate adhesive (super glue) and LEAKMASTER (LEAKMASTER is optional).
3. Seal watertight any exposed cells of HYDROTITE using LEAKMASTER.
4. Follow approved manufacturer written recommendations.
5. Install in longest length practicable.

C. Hydrophilic and PVC Intersections
1. Maintain continuity of waterstops at all intersections and transitions.
2. Joinery between PVC and HYDROTITE shall be sealed using LEAKMASTER.
3. Follow approved manufacturer written recommendations.

D. Retrofit Waterstop
1. Prepare existing concrete by grinding away irregularities. Clean concrete to ensure good epoxy bond.
2. Apply continuous bed of epoxy to concrete 1/8 inch thick.
3. Embed retrofit waterstop in uncured epoxy.
4. Mechanically fasten waterstop to concrete using stainless steel batten bars and anchor bolts staggered 6 inches OC max. Use batten bars on top and bottom.
5. Tool continuous layer of epoxy over batten bars and bolts to protect from corrosion.
6. Use expansion joint filler at moving joints to minimize shear stresses.

E. Concrete Placement at Waterstop
   1. Carefully place concrete without displacing waterstop from proper position.
   2. Thoroughly and systematically vibrate concrete around waterstop to obtain impervious, void free concrete in vicinity of joint and to maximize intimate contact between concrete and waterstop.
   3. After first pour, clean un-embedded waterstop leg to ensure full contact of second pour concrete.

END OF SECTION 03 15 13

SECTION 03 20 00 - CONCRETE REINFORCEMENT

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. Work Included: Perform all work necessary and required for the construction of the project as indicated. Such work includes but is not necessarily limited to the furnishing and installing of all reinforcing steel for the cast-in-place work and related items necessary to complete the work indicated on the drawings and described in the specifications.

B. Related Work in Other Section: The following items of associated work are included in other sections of these specifications:
   1. Concrete Formwork
   2. Cast-In-Place Concrete
   3. Anchors and miscellaneous metal items and inserts to be embedded in concrete.
   4. Post-Tensioned Concrete

1.2 CODES AND STANDARDS

A. Except as modified by the requirements specified herein and/or the details on the drawings, all work included in this section shall conform to the applicable provisions of the following codes and standards.

B. Concrete Reinforcing Steel Institute (CRSI):
   1. "Reinforced Concrete - A Manual of Standard Practice"
   2. "Recommended Practice for Placing Reinforcing Bars"
   3. "Recommended Practice for Placing Bar Supports"

C. American Concrete Institute (ACI):
   1. "Building Code Requirements for Reinforced Concrete", ACI 318
   2. "Manual of Standard Practice for Detailing Reinforced Concrete Structures", ACI 315
   3. "Specifications for Structural Concrete Buildings", ACI 301

D. American Society for Testing and Materials (ASTM): The specifications and standards hereinafter referred to latest edition.

E. Local Ordinances

1.3 SUBMITTALS

A. Fully detailed shop drawings, including bending schedules and bending diagrams, shall be submitted to the Engineer for approval. Shop drawings shall show placing details and size and location of all reinforcing steel.

B. Shop drawings shall be of such detail and completeness that all fabrication and placement at the site can be accomplished with the use of the shop drawings. Shop drawings shall include number of pieces, sizes, and markings of reinforcing steel, accessories, and any other information required for fabrication and placement.

C. Complete shop and placing drawings for all reinforced concrete work shall be drawn to a scale of 1/8" = 1'-0" or larger. Detail wall reinforcement on 1/4" = 1'-0" scale elevations. If so, detailed on structural plans, detail the top and bottom reinforcement on separate plans, each showing all bars, details, accessories, etc., required for proper fabrication and placement of that portion of the reinforcement.

D. Contractor shall check architectural, structural, mechanical, and electrical project or contract drawings for anchor bolt schedules and location, anchors, inserts, conduits, sleeves, and any other items which are required to be cast in concrete, and shall make necessary provisions as required so that reinforcing steel will not interfere with the placement of such embedded items.

E. Reinforcing steel shall not be fabricated or placed before the shop drawings have been approved by the Engineer and returned to the Contractor. Approval of shop drawings by the Engineer will not relieve the Contractor of responsibility for errors or for failure in accuracy and complete placing of the work.

F. Two copies of mill affidavits, stating the grades and physical and chemical properties of the reinforcing steel, shall be submitted to the Engineer before delivery of the steel to the job site.

1.4 PRODUCT HANDLING

A. Steel reinforcement shall be transported to the building site, stored, and covered in a manner which will ensure that no damage shall occur to it from moisture, dirt, grease, or any other cause that might impair bond to concrete. A sufficient supply of approved reinforcing steel shall be stored on the building site at all times to ensure that there will be no delay of the work. Identification of steel shall be maintained after bundles are broken.

1.5 STORAGE AND PROTECTION

A. Schedule reinforcement deliveries to minimize on site storage. Where such storage is unavoidable, place the reinforcement on blocks and cover.

B. Mild steel reinforcement at the time of placement of concrete shall be clean and free of all loose dirt, form oil, and other coatings affecting bond.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing bars shall be new, deformed billet steel bars, conforming to ASTM A615, Grade 60 (#3 bars may conform to ASTM A615, Grade 40).

B. Welded wire fabric shall be new, rectangular welded steel wire fabric, conforming to ASTM A185.

C. Anchoring hardware shall conform to the requirements set forth in the ACI 318 "Standard Building Code for Reinforced Concrete".

D. Reinforcing steel shall be bundled and tagged with grades and suitable identification marks for checking, sorting, and placing. Tags and markings shall be waterproof and shall not be removed until steel is placed.

E. Reinforcement accessories, consisting of spacers, chairs, ties, and similar items shall be provided as required for spacing, assembling and supporting reinforcement in place. All accessories shall be of plastic tipped galvanized steel, stainless steel or approved plastic conforming to the applicable requirements of the CRSI Standards hereinbefore specified.

F. Tie wires for reinforcement shall be 16 gage or heavier, where noted or specified, black or galvanized steel wire conforming to ASTM A82.

2.2 FABRICATION

A. Fabrication of steel reinforcement shall be in accordance with the details shown on the drawings and approved shop drawings. Where specific details are not shown or noted, comply with the applicable requirements of the "Codes and Standards" hereinbefore specified.

B. Bars shall be accurately bent, cut, and placed as indicated on the drawings. Bars shall be bent cold; heating of bars will not be permitted. Bars shall not be bent or straightened in any manner that will injure the material.

PART 3 - EXECUTION

3.1 PLACING

A. Reinforcing steel shall be placed in accordance with the drawings and approved shop drawings and the applicable requirements of the "Codes and Standards" hereinbefore specified. Install reinforcement accurately and secure against movement, particularly under the weight of workmen and the placement of concrete.

B. Bars shall be supported on chairs or spacers on metal hangers, accurately placed and securely fastened to steel reinforcement in place. Additional bars shall be supplied whether specifically shown on the drawings or not where necessary to securely fasten reinforcement in place. Support legs of accessories in forms without embedding in form surface. Spacing of chairs and accessories shall conform with CRSI's "Recommended Practice for Placing Bar Supports." Hooping and stirrups shall be accurately spaced and wired to the reinforcing. No wood or clay brick will be permitted inside forms.

C. All reinforcing shall be set in place, spaced, and rigidly and securely tied or wired at all splices and at all crossing points and intersections in the position shown, or as directed. Re-bending of bars on the job to fix existing conditions will not be permitted without the written approval of the Engineer. Point ends on wire ties away from forms.

D. Minimum center to center distance between parallel bars shall be in accordance with the details on the drawings or, where not shown, the clear spacing shall be 1-1/2 times the bar diameter but in no case less than 1-1/2 inches nor less than 1-1/3 times the maximum size aggregate.

E. Laps of splices, where shown or noted on drawings, shall be adequate to transfer stress by bond. Unless shown otherwise on drawings, lap bars a minimum of 32 diameters but in no case less than 12 inches. Whenever possible, splices of adjacent bars shall be staggered.

F. Welded wire fabric shall be in as long lengths as practicable and shall be wired at all laps and splices. Laps shall be ten inches (10"). End laps shall be offset in adjacent widths. Fabric shall be supported at four-foot maximum intervals by chairs or concrete bricks.

G. Dowels shall be tied securely in place before concrete is deposited. In the event there are no bars in position to which dowels may be tied, No. 3 minimum shall be added to provide proper support and anchorage. Bending of dowels after placement of concrete will not be permitted.

H. Except where shown otherwise on the drawings, the minimum concrete coverage for steel reinforcement shall be as follows:
   1. Where concrete is placed against earth.....3 inches
   2. Over column ties.....1-1/2 inches

3. Formed walls.....1-1/2 inches for bars No. 5 and smaller, and 2 inches for bars over No. 5 in size.

4. Suspended slabs.....1 inch for #11 and smaller 1-1/2 inches for greater than #11.

3.2 NOTIFICATION

A. Contractor shall notify the Engineer at least 72 hours ahead of each concrete pour, and no concrete shall be placed until all reinforcing steel has been installed by the Contractor and approved by the Engineer.

3.3 CORRECTION DURING CONCRETING

A. Capable ironworkers shall be kept on the work at all times during the placing of concrete and shall properly reset any reinforcement displaced by runways, workmen or other causes.

3.4 DEFECTIVE WORK

A. The following reinforcing steel work will be considered defective and may be ordered by the Engineer to be removed and replaced by the Contractor at no additional cost to the Owner.
1. Bars with kinks or bends not shown on drawings.
2. Bars injured due to bending or straightening.
3. Bars heated for bending.
4. Reinforcement not placed in accordance with the drawings and/or specifications.

END OF SECTION 03 20 00

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete reinforcement, for the following:
   1. Footings and/or piers.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Suspended slabs.
   5. Concrete toppings.
   6. Building frame members.
   7. Building walls.

B. Related Sections:
   1. Section 01 45 23 “Testing and Inspection Services”.
   2. Section 03 10 00 “Concrete Forming and Accessories”.
   3. Section 03 30 00 “Cast In Place Concrete”.
   4. Section 03 47 13 “Tilt Up Concrete”.
   5. Section 03 38 16 “Unbonded Post Tensioned Concrete”.
   6. Section 04 22 00 “Concrete Unit Masonry”.
   7. Section 31 20 00 "Earth Moving".
   8. Section 31 63 29 "Drilled Concrete Piers".

1.3 REFERENCES

A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
   1. American Concrete Institute (ACI)
      a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
      b. ACI 301 – Specifications for Structural Concrete for Buildings
      c. ACI 315 – Details and Detailing of Concrete Reinforcement
      d. SP-66 ACI Detailing Manual
   2. American Welding Society (AWS)
      a. AWS D1.1 – Structural Welding Code
   3. Concrete Reinforcing Steel Institute (CRSI)
      a. CRSI – Manual of Standard Practice
      b. CRSI 63 – Recommended Practice for Placing Reinforcing Bars
      c. CRSI 65 – Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.
   4. American Society of Testing Materials (ASTM)

a. ASTM-A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.
b. ASTM-A663: Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
c. ASTM-A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
d. ASTM-A675: Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
e. ASTM-A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
f. ASTM-A775: Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
g. ASTM-A884: Standard Specification for Epoxy-Coated Wire and Welded Wire Reinforcement.

B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement, according to ACI 315 “Details and Detailing of Concrete Reinforcement.”
1. Do not reproduce the structural drawings for use as shop drawings.

C. Bar Supports: Submit manufacturer’s product information for bolsters, chairs, spaces, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency, installer, and fabricator as indicated herein.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:
1. Steel reinforcement and accessories.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Refer Section 01 45 23.

B. Installer Qualifications: An experienced installer who has completed reinforcing installation work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

C. Fabricator Qualifications: An experienced fabricator who has completed reinforcing fabrication work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4, "Structural Welding Code - Reinforcing Steel."

E. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615, Grade 60 or Grade 75 as indicated on Drawings, deformed.

C. Low-Alloy-Steel Reinforcing Bars for bars to be welded: ASTM A 706, Grade 60 for #6 and smaller bars, Grade 75 for #7 and larger bars, deformed.

D. Add the following paragraph below for stainless-steel reinforcement. Retain one of two options for reinforcement type.

E. Stainless-Steel Reinforcing Bars: ASTM A 955, Grade 60, [Type 304] [Type 316L], deformed.

F. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.

G. Plain-Steel Wire: ASTM A 82, as drawn.

H. Deformed-Steel Wire: ASTM A 496.

I. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

J. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
   2. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." Combined tolerances for formwork, reinforcing fabrication, and reinforcing placement shall not permit a reduction in specified concrete cover of reinforcing steel. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken material. Bars used for concrete reinforcement shall meet following requirements for fabricating tolerances:
   1. Sheared length: Plus or minus 1 inch.
   2. Depth of truss bars: Plus 0, minus ½ inch.
   3. Overall dimensions of stirrups, ties, and spirals: Plus or minus ½ inch.
   4. Other bends: Plus or minus 1 inch.

B. For bars with end bearing splice couplers, bar ends shall terminate in flat surfaces, within 1.5 degrees of a right angle to axis of bars and shall be fitted within 3 degrees of full bearing after assembly.

2.4 DOWEL BAR ANCHORS/SPLICERS

A. Provide dowel bar anchors and threaded dowels designed to develop, both in tension and compression, 125% of the minimum ASTM specified yield strength of the dowel bars, as evidenced by published I.C.B.O. test reports. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by anchor supplier. The following dowel splicing systems are acceptable.
   1. Richmond Screw Anchor “Dowel Bar Splicer”
   2. Erico “Lenton Form Saver”
   3. Dayton Barsplice “Grip-Twist”

2.5 MECHANICAL SPLICES

A. A. Provide mechanical splices designed to develop, both in tension and compression, 125% of minimum ASTM yield strength of the smaller bar being coupled, as evidenced by published I.C.B.O test reports. The following bar splicing systems are acceptable.
   1. Erico “Cadweld C-Series”
   2. Erico “Lenton”
   3. Dayton Barsplice “Bar Grip”

4. Dayton Barsplice “Grip Twist”

2.6 METAL ANCHORAGE AND EMBEDDED METAL ASSEMBLIES

A. Steel Shapes and Plates: Conform to ASTM A36, “Specification for Structural Steel”.

B. Headed Stud Anchors: Headed studs welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.

C. Welding Electrodes: AWS 5.5, Series E70.

D. Welded Deformed Bar Anchors: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.

E. All metal assemblies exposed to earth, weather, or moisture, including exposure to a crawl space environment, shall be hot dip galvanized.

2.7 FABRICATION OF METAL ACCESSORIES AND EMBEDDED METAL ASSEMBLIES

A. Fabricate and assemble structural steel items in the shop. Shearing, flame cutting, and chipping shall be done carefully and accurately. Holes shall be cut, drilled, or punched at right angles to the surface of metal and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges. Welded construction shall conform to AISC “Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings,” and AWS D1.1. Welding shall be done by AWS certified welders.

B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division of KSM Welding Services Division, Omark, Ind. A minimum of two headed studs shall be tested at start of each production period for proper quality control. Studs shall be capable of being bent 45 degrees without weld failure.

C. Welding of reinforcement shall be done in strict accordance with AWS requirements, using recommended preheat temperature and electrode for type of reinforcement being welded. Bars larger than No. 9 shall not be welded. Welding shall be performed subject to the observance and testing laboratory. Under no circumstances is ordinary reinforcing (ASTM A615) to be welded.

D. Coatings, where required, shall be applied after fabrication and prior to casting concrete.

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.2 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Provide minimum concrete covering for reinforcement as shown in the Structural General Notes.
G. Place bars to following tolerances:
1. Clear distance to formed surfaces: Plus or minus 1/4 inch.
2. Minimum spacing between bars: Minus 1/4 inch.
3. Top bars in slabs and beams:
a. Members 8 inches deep or less: Plus or minus 1/4 inch.
b. Members between 8 and 24 inches deep: Plus or minus 1/2 inch.
c. Members more than 24 inches deep: Plus or minus 1 inch.

4. Crosswise of members: Spaced evenly within 2 inches.
5. Length of members: Plus or minus 2 inches.

H. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If moved more than one bar diameter, or enough to exceed above tolerances, resulting arrangement of bars subject to approval.

I. Support reinforcement and fasten together to prevent displacement by construction loads or placing concrete beyond tolerances indicated.

J. Unless permitted by Engineer, do not bend reinforcement after embedding in hardened concrete.

3.3 FIELD QUALITY CONTROL

A. Testing and Inspecting: See Section 01 45 23.

B. Inspections:
   1. Steel reinforcement placement.
   2. Steel reinforcement welding.

END OF SECTION 03 20 00

SECTION 03 21 00 - REINFORCING STEEL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

GENERAL

1.0 DESCRIPTION

This item shall govern for the furnishing and placing of reinforcing steel of the type, size and quantity designated for use in structures, as shown on the plans and in accordance with these specifications.

2.0 MATERIALS

Unless otherwise designated on the plans, or herein, all bar reinforcement shall be deformed and shall conform to the following:

A. ASTM Designation A615, Grade 40 or 60, open hearth, basic oxygen or electric furnace new billet steel.
Unless noted by these specifications, rail steel or axle steel shall not be permitted. When no specific grade is specified on the plans, the reinforcing steel shall be a minimum Grade 60.

Where bending of bar sizes #14 or #18 of Grade 60 is required, bend testing shall be performed on representative specimens as described for smaller bars in the applicable ASTM Specification. The required bend shall be 90 degrees around a pin having a diameter of 10 times the nominal diameter of the bar.

B. Spiral reinforcement shall be either smooth or deformed bars or specified herein. Bars for spiral reinforcement shall comply with ASTM Designation A675, A615 or A617. Wire shall conform to ASTM Designation A82. Unless otherwise shown on the plans, the minimum yield strength for spiral reinforcement shall be 40,000 psi. Report of chemical analysis, showing the percentages of carbon, manganese, phosphorus and sulphur will be required of all reinforcing steel bars when it is to be welded.

3.0 BENDING

The reinforcement shall be bent cold, true to the shapes indicated on the plans. Bending shall preferably be done in the shop. Irregularities in bending shall be cause for rejection. Unless otherwise shown on the plans, bends shall be made in accordance with ACI 315.

4.0 FABRICATING TOLERANCES

Fabricating tolerances for bars shall be as indicated in ACI 315.

5.0 STORING

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids or other supports and shall be protected from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil or other foreign materials.

Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum

dimensions, cross-sectional area and tensile proportions of a hand wire brushed specimen meets the physical requirements for the size and grade of steel specified.

6.0 LAP SPLICES

Splicing of bars, except where shown on the plans, will not be permitted without prior approval of the Engineer. Splices, not provided for on the plans, will be permitted in slabs not more than 15 inches in thickness, columns, walls and parapets subject to the following:

Splices will be permitted in bars 30 feet or less in plan length. For bars exceeding 30 feet in plan length, the distance center to center of splices shall not be less than 30 feet minus one splice length, with no more than one individual bar length less than 10 feet. Splices not shown on the plans, but permitted hereby, shall be made in accordance with Table No. 5. The specified concrete cover shall be maintained at such splices and bars placed in contact and securely tied together. Lap bars so that both bars will be in the same plane parallel to the nearest concrete surface.

Table No. 5
Minimum Lap Requirements

Size #	Grade 40	Grade 60
3	1' - 0"	1' - 0"
4	1' - 2"	1' - 9"
5	1' - 5"	2' - 2"
6	1' - 9"	2' - 7"
7	2' - 4"	3' - 5"
8	3' - 0"	4' - 6"
9	3' - 10"	5' - 8"
10	4' - 10"	7' - 3"
11	5' - 11"	8' - 11"

Spiral steel will be lapped a minimum of one turn. Sizes #14 and #18 may not be lapped.

7.0 WELDED SPLICES

Where shown on the plans or required by the provisions of this item or other pertinent specifications, welded bar splices shall be used. All welding operations, processes, equipment, materials, workmanship and inspection shall conform to the American Welding Society Specification D1.4. For bars #6 and smaller, use lap weld splices with fillet welds equal to one half bar diameter on each side, for 4 inches in length. For bars #7 and larger, use butt weld splices in accordance with AWS D1.4.

All splices whether lap, weld, mechanical or coupler, shall develop the full strength of the bar. Information on mechanical splicing devices and couplers shall be submitted for approval prior to use.

8.0 PLACING

Steel reinforcement shall be placed in the exact position as shown on the plans and held securely in place during the placing of the concrete. The dimensions shown are to centers of bars, unless otherwise noted. Hold bars securely in place with wire and other approved means during placement of concrete.

A. In plane of steel parallel to nearest surface of concrete, bars should not vary from plan spacing by more than one twelfth of spacing between bars.

B. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

Space steel the required distance from forms or earth by approved galvanized metal spacers, metal spacers with plastic coated tips, stainless steel spacers, plastic spacers, or approved precast mortar or concrete blocks. For approval of plastic spacers, provide samples of plastic, which show no indications of deterioration after immersion in a 5 percent solution of sodium hydroxide after 120 hours.

Before any concrete is placed, all mortar, mud, dirt, etc., shall be cleaned from reinforcement. No concrete shall be deposited, until the Engineer has inspected the placement of the reinforcing steel and given permission to proceed.

9.0 SUBMITTALS

The following information shall be submitted for reinforcing steel. Six sets of each item shall be submitted.

A. Product data for all materials used.

B. Shop drawings indicating locations, placement, sizes and bending. Shop drawings shall be in accordance with the ACI Manual of Practice for Detailing Reinforced Concrete Structures.

C. When welding is required, furnish report of chemical analysis, showing percentages of carbon, manganese, phosphorus and sulphur.

D. Submit certified copies of mill certificates of compliance with requirements herein specified.

E. Submit information on mechanical splicing devices, couplers, and all other reinforcing accessories.

10.0 MEASUREMENT & PAYMENT

Reinforcing steel quantities will not be measured or paid for directly. All costs of furnishing, fabrication, placement, ties, chairs, bending, labor and equipment shall be considered subsidiary to bids for concrete structures, requiring reinforcement.

END OF SECTION 03 21 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Labor, materials, services and equipment required in conjunction with or properly incidental to placing of cast-in-place concrete slabs, building members, and MEP equipment pads as described herein or as shown on the Drawings, including but not limited to:
   1. Concrete mix designs.
   2. Assistance with Owner provided laboratory testing of concrete.
   3. Installation of items to be built-in formwork or embedded in concrete but furnished by other trades, including metal anchors, anchor slots, reglets, hangers, supports, ties, inserts, bolts, corner guards, and sleeves.
   4. Cast-in-place concrete, with formwork, under slab vapor barrier, reinforcing, accessories, appurtenances, finishing and curing required to complete concrete work.
   5. Grouting under structural steel base plates.
   6. Foundation for columns, walls, and slabs on grade.
   7. Super-structure for walls, columns, slabs, curbs, stairs, steps, equipment pads, walks, and pre-molded expansions joints.

B. Examine the drawings for Plumbing, Mechanical, and Electrical work. These subcontractors will furnish and set sleeves or box forms required for openings. Contractor shall use care in placing reinforcement and pouring concrete so as not to displace such sleeves or boxes.
   1. All slots, chases, recesses, or openings indicated on the drawings, which are not formed by sleeves or boxes shall be provided in locations shown. When the work of other contractors is completed, the excess part of the openings shall be completely closed with concrete.

1.2 RELATED REQUIREMENTS

A. Division 1 Sections applicable to the Work of this Section.

1.3 RELATED SECTIONS

A. Section 01 45 23 - Testing and Inspection Laboratory Services

B. Section 02 32 00 - Geotechnical Report

C. Section 31 00 00 - Earthwork

D. Section 31 62 13.16 - Drilled and Reamed Foundation

E. Section 32 13 13 - Concrete Paving

F. Section 07 92 00 - Joint sealants

G. Electrical and Mechanical Drawings and Specifications for sleeves, conduit, and other items embedded in concrete.

1.4 QUALITY ASSURANCE

A. Where standards or requirements of this Section conflict with those noted on the Contract Drawings, or the Building Code, the more stringent requirements shall govern. Bring all conflicts and discrepancies to the attention of the Architect and do not start work until such conflicts and discrepancies are clarified and corrected. Failure to do so will not relieve the Contractor from performing the Work correctly at no additional expense to the Owner.

B. Testing Laboratory Services:
   1. Test results shall meet or exceed established standards. A technician from the Owner's Testing Laboratory must be present during all operations.

C. Evaluation and Acceptance:
   1. Codes and Standards: The Work described in this Section, unless otherwise noted on the Drawings, or herein specified, shall be governed by the editions of the following codes or specifications approved by authorities having jurisdiction.
      a. American Association of State Highway and Transportation Officials (AASHTO)
         1) TP 23, "Proposed Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying"

      b. American Concrete Institute (ACI)
         1) 211.1, "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete"
         2) 214, "Recommended Practice for Evaluation of Strength Test Results of Concrete"
         3) 301, "Specifications for Structural Concrete for Buildings"
         4) 302, "Guide for Concrete Floor and Slab Construction"
         5) 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"
         6) 305, "Hot Weather Concreting"
         7) 306, "Cold Weather Concreting"
         8) 309, "Standard Practice for Consolidation of Concrete"
         9) 311, "ACI Manual of Concrete Inspection"
         10) 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures"
         11) 318, "Building Code Requirements for Reinforced Concrete"
         12) 347, "Recommended Practice for Concrete Formwork"
         13) 355.2, "Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary"
         14) Keep one copy of "Manual of Concrete Practice" at job site at all times.

      c. American Society for Testing and Materials (ASTM)
         1) A36, Standard Specification for Carbon Structural Steel
         2) A108, Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
         3) A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
         4) A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
         5) A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
         6) A704, Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
         7) C33, Standard Specification for Concrete Aggregate
         8) C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

9) C94, Standard Specification for Ready-Mix Concrete
10) C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates
11) C150, Standard Specification for Portland Cement
12) C172, Standard Practice for Sampling Freshly Mixed Concrete
13) C260, Standard Specification for Air-Entraining Admixtures
14) C330, Standard Specification for Lightweight Aggregates for Structural Concrete
15) C494, Standard Specification for Chemical Admixtures for Concrete
16) C595, Standard Specification for Blended Hydraulic Cements
17) C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
18) C979, Standard Specification for Pigments for Integrally Colored Concrete
19) C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
20) C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
21) E96, Standard Test Methods for Water Vapor Transmission of Materials
22) E1643, Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs
23) E1745, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
24) F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

d. American Welding Society (AWS)
1) D1.4 Structural Welding Code- Reinforcing Steel

e. Federal Specification (FS)
1) FF-S-325
2) QQ-Z-325C

f. Concrete Reinforcing Steel Institute (CRSI)
1) “Reinforced Concrete – A Manual of Standard Practice”
2) “Recommended Practice for Placing Reinforcing Bars”
3) “Recommended Practice for Placing Bar Supports”

D. Source Quality Control:
1. Concrete production facilities shall meet the requirement for certification by the National Ready Mixed Concrete Association. All ready-mix concrete trucks proposed for use on the project shall meet the requirements of NRMCA, Certification of Ready Mix Concrete Production Facilities.
2. Concrete batchers shall be completely interlocked semi-automatic or automatic batchers, as defined by the Concrete Plant Manufacturers Bureau.
3. Concrete batchers shall have graphic, digital, or photographic recorders, which shall register both empty balance and total weight (or volume of water or admixture) of each batched material, time to the nearest minute, date, identification of batch, and numerical count of each batch. Copies of the record shall be furnished to the Inspection and Testing Laboratory.
4. The Inspection and Testing Laboratory shall provide concrete batch plant inspection as follows:
a. Provide a qualified inspector with necessary equipment and apparatus to inspect weighing and batching of controlled concrete at batch plant on a random basis, approximately once daily as the concrete is being placed on this project.
b. Make certain that materials and batch equipment used are in accordance with requirements of Specifications.

c. Check for adjustment in batch weights to compensate for variations in moisture content.
d. Submit promptly to Architect, certification of weights used in loads of acceptable concrete which has been batched during plant inspection time.

E. Concrete Mix Design Criteria:
1. Design concrete mixes in accordance with ACI 318, Section 5.3, Proportioning on the basis of field experience and/or trial mixtures.
2. Submit the proposed mix designs for each concrete mix type proposed.
3. Determination of required average strength above specified strength shall be in accordance with ACI 318.
4. If trial mixes are used as the basis for the proposed mix design, mold and cure test cylinders in accordance with ASTM C39. Do not place concrete on project until laboratory reports and results of confirmation cylinder tests have been evaluated by the Inspection and Testing Laboratory and results indicate that proposed mixes will develop required strengths.
5. Inspection and Testing Laboratory shall furnish the Architect with a written evaluation of each proposed concrete mix design submitted by the Contractor.
6. Check mix designs and revise if necessary wherever changes are made in aggregates or in surface water content of aggregate or workability of concrete. Water content shall be minimum to produce workable mix. The water content shall be verified in the field by use of the Microwave Test.

1.5 SUBMITTALS

A. Mix Designs: Submit proposed mix designs, including confirmation cylinder test results, in accordance with ACI 318, Section 5.3, Proportioning on the basis of field experience and/or trial mixtures. Submit mix designs to Architect/Engineer and Inspection and Testing Laboratory for evaluation a minimum of 14 days prior to placing concrete. Key requirements:
1. Combined aggregate gradation**.**
2. Proportions of cement, fine and coarse aggregates, and water.
3. Type, color and dosage of integral coloring compounds, where applicable.
4. Range of ambient temperature and humidity for which design is valid.
5. Any special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product.

B. Complete test data for trial mixes or a complete summary of previous project test results for mix design based on standard deviation analysis must be included.

C. Provide duplicate delivery tickets for each load of ready-mix concrete delivered to site, in accordance with ASTM C94. Show batch weights on each ticket.

D. Provide mill test reports on an as-used basis for each type and brand of cementitious material used.

E. Provide certification from independent test laboratory indicating under slab vapor retarder compliance with specification and ASTM 1745 Class A requirements.

F. Provide product data for each accessories item specified but necessarily not listed above which are required for a complete installation, including, but not limited to reinforcing, chairs, admixtures, stains and color pigments, grouts, sealers, vapor retarders and barriers, water stops, epoxy adhesives, curing compounds and anchors.

G. Provide Shop Drawings for all reinforcing steel. Show bending diagrams, splicing and laps of rods, shapes, dimensions and details of bar reinforcement and accessories.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Mix and deliver concrete to project ready-mixed in accordance with ASTM C94. Mix concrete a minimum of 70 revolutions of transit mix drum at mixing speed. A minimum of 40 revolutions shall be at the production plant.

B. Schedule delivery so that continuity of any pour will not be interrupted for over 15 minutes.

C. Place concrete on site within 90 minutes after proportioning materials at batch plant.

D. Store bagged cement on platforms off ground. Protect stored cement against the elements. Handle and store fine and coarse aggregate separately in manner to prevent intrusion of foreign material or segregation of the material. Protect all reinforcement until used. Do not use any hardened cement.

E. Mild steel reinforcement at the time of placement of concrete shall be clean and free of all loose dirt, form oil, and other coatings affecting bond.

1.7 JOB CONDITIONS

A. Hot Weather Concreting:
   1. Follow ACI 301 and ACI 305.
   2. Provide water-reducing retarding admixture conforming to ASTM C494, Type D when necessary to retard initial set. The admixture shall be dispensed in accordance with manufacturer's recommendations.
   3. Maximum concrete temperature shall not exceed 95 degrees F at time of placement.
      a. Concrete with temperatures above 90 degrees F shall be placed only if a high range water reducer (superplasticizer) is added to the mix as directed by the Testing Laboratory to maintain the specified slump during placement.

B. Cold Weather Concreting: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures.
   1. Follow ACI 301 and ACI 306.
   2. When ambient temperature at site is below 40 degrees F or is expected to fall to that temperature within ensuing 24 hours, heat water and/or aggregate prior to adding to mix so that temperature of concrete will be between 55 degrees F and 85 degrees F at time of placement.
   3. Maintain temperature of deposited concrete between 50 degrees F and 70 degrees F for minimum of seven (7) days after placing.
   4. Add the specified non-corrosive accelerator for all floor concrete placed at air temperatures below 50 degrees F.

C. Temperature Changes: Maintain changes in concrete temperature as uniformly as possible, but in no case exceed change of 5 degrees F per hour or 25 degrees F in any 24-hour period.

D. Combustion heaters shall not be used during the first 48 hours without precautions to prevent exposure of concrete and workmen to exhaust gasses containing carbon dioxide and/or carbon monoxide.

E. Admixtures intended to accelerate hardening of concrete or produce higher than normal strength at early periods will not be permitted unless approved by the Architect. The use of calcium chloride is specifically prohibited.

1.8 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Management and Coordination.

1.9 SEQUENCING/SCHEDULING

A. Coordinate Work of this Section with work of other Sections as required to properly execute the Work and as necessary to maintain satisfactory progress of the work of other Sections.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Manufacturers named within this Section are approved for use on the Project for the product for which they are specified. Other manufacturers must have a minimum of five (5) years of experience manufacturing the product specified and meet or exceed the specifications for that product. Substitution of products must be in accordance with the General Conditions, Supplementary Conditions, and Section 01 33 00, Submittals to be considered prior to proposal.

2.2 MATERIALS

A. Formwork:
   1. General: Contractor may use any of the following formwork materials as long as material meets the following and will not stain, or impart any undesirable texture, i.e. wood grain, where such texture would be objectionable in an exposed location.
      a. Wood Forms:
         1) Plywood: PS 1, Douglas Fir or Spruce species.
         2) Medium Density Overlay (MDO): One (1) side grade; sound undamaged sheets with clean, true edges.
         3) Lumber: Southern Yellow Pine species; No. 2 grade, with grade stamp clearly visible.

      b. Prefabricated Forms:
         1) Preformed Steel Forms: Minimum 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
         2) Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

      c. Form Liner: Any material recommended by manufacturer to impart finish which will exhibit the finish or design characteristics, i.e. smooth, textured, ribbed, etc. detailed by the Architect for exposed locations as shown or required and capable of being stripped from complex designs without damaging the finish or design. Form liner shall be as manufactured by Symons by Dayton Superior or Architect approved equal.

      d. Self-expanding corkboard expansion joint fillers should conform to ASTM D1752 for exterior work. Joint fillers shall extend full depth of slab or joint and be of thickness and lengths indicated on drawings.

B. Metal Reinforcement:
   1. Bars:
      a. General: Conform to ACI 315, latest edition.
      b. Comply with ASTM A615, Grade 60.
      c. Number 3 bars comply with ASTM A615, Grade 40

   2. Welded Steel Wire Fabric (Mesh): Not permitted in structural concrete, unless approved by Structural Engineer

C. Concrete, General:
   1. Ready-mixed concrete, ASTM C94
   2. Comply with ACI 318.
   3. Concrete must be approved by Architect through design mix and cylinder test of testing laboratory.
   4. Unless approved otherwise by the Architect, use one (1) brand of cement throughout the work where finished surface will be exposed to view.
   5. Strength: Refer to Paragraph 2.3, A.

D. Concrete Materials:
   1. Cement:
      a. Portland Cement, Type I or III, conforming to the requirements of ASTM C150.
      b. Combined aggregate gradation for slabs and other designated concrete shall be 8 percent - 18 percent for large top size aggregates (1-1/2 in.) or 8 percent - 22 percent for smaller top size aggregates (1 in. or 3/4 in.) retained on each sieve below the top size and above the No. 100.

   2. Fly ash: Not permitted.

E. Aggregate:
   1. Fine Aggregate: ASTM C33; clean, hard, durable, uncoated, natural and manufactured sand, free of silt, loam or clay.
   2. Coarse Aggregate: ASTM C33; hard, durable, uncoated, crushed stone; gradation in accordance with Size No. 467 for piers and concrete footings and Size No. 67 for all other concrete. Maximum aggregate size in accordance with ACI 318.
   3. Grading shall be in accordance with “Standard Method for Fine Analysis of Sieve and Coarse Aggregates” (ASTM C136).

F. Water: ASTM C94, Paragraph 4.1.3; potable, clean and free from oil, acid and injurious amount of vegetable matter, alkalies, and other impurities.

G. Admixtures:
   1. Cement-dispersing, water-reducing types. Admixtures shall conform to ASTM C494, Type A or D, and shall be used strictly in accordance with manufacturer's recommendations and as determined by the Inspection and Testing Laboratory. Admixture shall not discolor concrete or in any way affect the appearance of the concrete.
      a. High-range water reducing admixture conforming to ASTM C494, Type F or G shall be used as required and shall be one (1) of the following or Architect approved equal:
         1) Eucon 37 (Type F), Eucon 537 (Type G) by The Euclid Chemical Company
         2) Master Rheobuild 1000 (Type F), Rheobuild 716 (Type G) by BASF Admixtures
         3) Sikament 300 (Type F), Sikament 86 (Type G) by Sika Corp.
         4) WRDA-19 (Type F), Daracem 100 (Type G) by GCP Applied Technologies

   2. An air-entraining admixture conforming to ASTM C260 shall be used as required on the Drawings and shall be one (1) of the following or Architect approved equal:
      a. Air-Mix or AEA-92 by The Euclid Chemical Company
      b. Sika Aer by Sika Corporation
      c. MB-VR or MB-AE by BASF Admixtures

   3. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.
   4. Certification: Written conformance to the above-mentioned requirements and the chloride ion content of admixtures will be required from the admixture manufacturer prior to mix design review by the Architect/Engineer.

H. Non-Shrink Cement Grout:
   1. The non-shrink grout shall be a factory pre-mixed grout and shall conform to ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 4 foot x 4 foot base plate. Provide one (1) of the following or Architect approved equal:
      a. NS Grout by The Euclid Chemical Company
      b. Five Star Grout by U.S. Grout LLC
      c. Horn Non-Corrosive Non-Shrink Grout by Tamms Industries
      d. Duragrout by L & M Construction Chemicals, Inc.
      e. Masterflow 713 by BASF Admixtures
      f. SikaGrout 212 by Sika Corp.
      g. Sonogrout 10K by Sonneborn
      h. 588 Grout by W. R. Meadows, Inc.
      i. US SPEC GP Grout by US Mix Products Company

   2. High Flow Grout: Where high fluidity and/or increased placing time is required, use high flow grout. The factory pre-mixed grout shall conform to ASTM C1107, "Standard Specification for Packages Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 18 inch x 36 inch base plate. Provide one (1) of the following or Architect approved equal:
      a. Hi-Flow Grout by The Euclid Chemical Company
      b. Crystex by L & M Construction Chemicals, Inc.
      c. Masterflow 928 by BASF Admixtures
      d. CG-86 Grout by W. R. Meadows, Inc.
      e. US SPEC MP Grout by US Mix Products Company

I. Non-Oxidizing Metallic Hardener: (For use at Loading Dock where shown)
   1. Non-Oxidizing Metallic Floor Hardener: The specified non-oxidizing metallic floor hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specially processed non-rusting aggregate, selected portland cement and necessary plasticizing agents. Product shall be Diamond-Plate by The Euclid Chemical Company or Architect approved equal.

J. Evaporation Retardant:
   1. Evaporation Retardant shall be a thin, continuous film which prevents rapid moisture loss from the concrete surface. For use when concrete operations must be performed in direct sun, wind, high temperatures, or for relative humidity. Products: Subject to compliance with requirements, provide one (1) of the following or Architect approved equal:
      a. Eucobar by The Euclid Chemical Company
      b. Confilm by BASF Admixtures
      c. Evapre by W. R. Meadows, Inc.
      d. US SPEC Monofilm ER by US Mix Products Company.
      e. E-Con by L& M Construction Chemicals

K Sealer/Densifier: Provide "Euco Diamond Hard" by The Euclid Chemical Company, "Sealhard" by L&M Construction Chemicals, or equal by Master Builders, Sika Corp., Sonneborn, US SPEC, or Architect approved equal.

L. Chemical Hardener/Dustproofer: Provide "Surfhard" by The Euclid Chemical Company, "Chemhard" by L&M Construction Chemicals, or equal by Master Builders, Sika Corp., Sonneborn, US SPEC, or Architect approved equal.

M. Curing Compound: dissipating resin type, which chemically breaks down after approximately eight (8) weeks. Membrane forming compound shall meet ASTM C309, Types 1 and 1D Class B, water based, VOC/AIM Compliant. Provide “Kurez DR VOX” by The Euclid Chemical Company, “Cure R” by L&M Construction Chemicals, “1100 Clear” by W. R. Meadows, Inc., US SPEC “Maxcure Resin Clear” by US Mix Products Company, or equal by Master Builders, Sika Corp., BASF, or Architect approved equal.

N. Curing and Sealing Compound: high solids acrylic copolymer emulsion blend. Membrane forming compound shall meet ASTM C1315, Type 1 Class B. Provide “Super Rez-Seal” by The Euclid Chemical Company, “Dress & Seal” by L&M Construction Chemicals, “VOCOMP 25 1315” by W. R. Meadows, Inc., US SPEC “CS-25-1315” by US Mix Products Company, or equal by Master Builders, Sika Corp., BASF, or Architect approved equal.

O. Epoxy Adhesive for rebar and threaded rod dowelling: Adhesive anchors shall have been tested and qualified for use in accordance with ICC-ES AC308 for cracked and uncracked concrete recognition. Size and location of anchors shall be as indicated on the drawings. Provide one (1) of the following or Structural approved equal:
1. Simpson Strong-Tie SET-XP (ICC-ES ESR-2508)
2. Hilti Corp. RE 500-SD (ICC-ES ESR-2322)
3. Powers Fasteners PE1000+ (ICC-ES ESR-2583)

P. Epoxy Adhesive to bond fresh concrete to hardened concrete and grout base plates: ASTM C881, two (2) component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces. Provide one (1) of the following or Architect approved equal:
1. Euco #452 Epoxy System or Euco #620 Epoxy System by The Euclid Chemical Company
2. Sikadur Hi-Mod by Sika Corp.
3. Rezi-Weld 1000 by W. R. Meadows, Inc.
4. US SPEC Maxibond 2500 by US Mix Products Company.
5. Epobond by L& M Construction Chemicals.

Q. Underslab Vapor Retarders and Barriers:
1. Vapor Retarder Membrane:
   a. Requirements:
      1) Class: ASTM E1745, Class A.
      2) Water Vapor Permeance: ASTM E96, 0.015 perms maximum.
      3) Tensile Strength: ASTM E154 (Section 9, Average), 45.0 pounds per inch, minimum.
      4) Puncture Resistance: ASTM D1709 (Method B), 2400 grams, minimum.

   b. Provide compatible seam taping and pipe boots or sealing mastic in accordance with manufacturer’s requirements.
   c. Provide proof of compliance to Architect at time of delivery of materials.
   d. Provide one (1) of the following under entire slab, unless noted otherwise:
      1) Barrier Bac-Inc “VB-350”
      2) Insulation Solutions, Inc. “Viper II 15 mil”
      3) Raven Industries, Inc. “VaporBlock 15”
      4) Reef Industries, Inc. “Griffolyn 15 Mil Green”
      5) Stego Industries, LLC “Stego-Wrap 15-mil”
      6) Tex-Trude, “Xtreme 15 Mil”
      7) W. R. Meadows, Inc. “Perminator 15”

2. Vapor Barrier: Under Wood Floors at Gymnasiums, Stages, and Dance Floors, and at Auditorium Areas Below Finish Floor Level: Premoulded Membrane Vapor Seal with Plasmatic Core manufactured by W.R. Meadows, Inc., Hempshire, IL; or Architect approved equal.

3. Below Grade Waterproofing: Provide below grade waterproofing at vertical walls below grade and beneath elevator pit in accordance with Section 07 16 00.

R. Miscellaneous Structural Metals Associated with Structural Concrete:
1. Structural steel pieces, including miscellaneous structural metals placed in concrete, exposed to weather, in permanent contact with soil, or accessible to salt intrusion shall be hot dipped galvanized in accordance with ASTM A123.
2. Structural steel pieces embedded in concrete shall conform to ASTM A36, unless noted otherwise on the Drawings.
3. Welding of inserts, anchors and other steel pieces used in conjunction with structural concrete shall conform to AWS Dl.4.
4. Welding of reinforcing steel used in conjunction with structural concrete shall conform to AWS Dl.4.
5. Headed stud anchors shall conform to ASTM A108, minimum tensile strength 60,000 PSI.
6. Mechanical and screw anchors shall have been tested and qualified for use in Accordance with ACI 355.2 and ICC ES AC193 for cracked and uncracked concrete recognition. Size and location shall be as indicated on the Drawings. Provide one (1) of the following or Structural approved equal.
   a. Simpson Strong-Tie Strong-Bolt wedge anchor (ICC-ES ESR-1771)
   b. Simpson Strong-Tie Strong-Bolt 2 wedge anchor (ICC-ES ESR-3037)
   c. Simpson Strong-Tie Titen HD screw anchor (ICC-ES ESR-2713)
   d. Hilti Corp. Kwik-Bolt TZ wedge anchor (ICC-ES ESR-1917)
   e. Hilti Corp. Kwik HUS-EZ screw anchor (ICC-ES ESR-3037)
   f. Hilti Corp. HAD undercut anchor (ICC-ES ESR-1546)
   g. Powers Fasteners Power-Stud+ SD2 wedge anchor (ICC-ES ESR-2502)
   h. Powers Fasteners Wedge-Bolt+ screw anchor (ICC-ES ESR-2526)
   i. Powers Fasteners Atomic+ undercut anchor (ICC-ES ESR-3067)

S. Miscellaneous Materials and Accessories:
1. Form ties: Adjustable length and type which will not leave holes larger than 1 inch in diameter in face of concrete. Ties shall be such that when forms are removed, no metal will be within 1 inch of the finished concrete surface. The holes must be patched.
2. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages, Fasteners: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
3. Form Release Agent: Colorless mineral oil which will not stain concrete or absorb moisture.
4. Chairs and Spacers: Heavy-duty plastic-type sized to support all reinforcing steel to proper height. Use type with sand cushion pads where concrete is on grade. Provide chairs and spacers Series “B” by W.H.C. Products, Inc., E-Z Chair by Aztec Concrete Accessories, Inc., GTI Bar Chair by General Technologies, Inc., or Architect approved equal.
5. Waterstops:
   a. Ribbed flat 3/16 inch by six (6) inch with 1/8 inch ribs, rated for 75 foot of head pressure. Provide factory made corner fittings weld splices with thermostatically controlled heating iron. Style No. 782 by Greenstreak, Inc., or Architect approved equal.
   b. Contractor’s Material Option: Specially formulated preformed joint sealant that provides a lasting,, watertight bond to both fresh and cured concrete surfaces. Synko-Flex Preformed Plastic Adhesive Waterstop and Synko-Flex Primer manufactured by Synko-Flex Products, Division of Henry Company, Houston, Texas; (713) 671-9502 or Architect approved equal.
6. Carton Void Forms: If shown or required, shall be wax coated corrugated paper material, rectangular in shape and same width as the grade beams, with 1/8-inch thick tempered hardboard for top plane. Provide void forms as required (i.e. with curves, radial) that have vertical supported edges adjacent to all drilled piers, in order to prevent damage to the interior supporting network caused by field cutting.
7. Soils retainers: If shown or required, shall be composed of lightweight, plastic material that is not adversely affected by moisture. They must be flexible, impact resistant and must be

able to resist lateral loads applied by the soils. Retainers shall extend both 6" above and below the top and bottom of void forms.

8. Corners: Chamfer, wood strip type; one (1) inch x one (1) inch size; maximum possible lengths.
9. Dovetail Anchor Slot: Galvanized steel, 22 gauge thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
10. Flashing Reglets: Galvanized steel, 22 gauge thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
11. Bonding Agent: Acrylic latex emulsion type as recommended for bonding new concrete to old concrete.
12. Integral Color Pigment (If shown or required): Mineral oxide, lightfast, lime-proof, water-resistant type conforming to ASTM C979. Color(s) shall be as selected by Architect from manufacturer's standard color line. Provide one (1) of the following or Architect approved equal:
    a. ChemSystems, Inc.
    b. Davis Colors
    c. New Riverside Ochre Co., Inc.
    d. L.M. Scofield Company
13. Color Stain (If shown or required): A chemically reactive stain, designed for adding variegated color to new or old concrete. Color(s) shall be as selected by Architect from manufacturer's standard color line. Provide Lithochrome Chemstain by L.M. Scofield Company or Architect approved equal.
14. Joint Sealants: Refer to Section 07 92 00, Building Sealants

2.3 CONCRETE MIXES

A. Strength: Concrete is classified and specified by ultimate compressive strength (f c) at the age of 28 days. Unless indicated otherwise on the Drawings, strengths shall be as follows:
    1. All concrete including grade beams, footings, slabs, and pads: 5 sack/3,000 psi/28 days.
    2. Strength recommendations on Structural Drawings supersede when they are greater than specified here.

B. Interior slabs subjected to vehicular traffic: This concrete shall have a maximum W/cm of 0.48 and maximum air content of 3 percent. No air-entraining admixture shall be added to this mix.

C. Concrete permanently exposed to freezing and thawing shall conform to Chapter 4 – Durability Requirements of ACI 318. W/cm and air content ratios shall coincide with its respective Exposure Class.

D. Proportions: Proportions of cement, aggregate, admixture and water to attain required plasticity and compressive strength shall be in accordance with ACI 318, Section 5.3, Proportioning on the basis of field experience and/or trial mixtures. Do not make changes in proportions without submitting proposed changes to Inspection and Testing Laboratory for evaluation.
    1. Trial mixtures having proportions and consistencies suitable for the work shall be made based on ACI 211. 1, using at least three (3) different water-cement ratios which will produce a range of strengths encompassing those required for this project.
    2. Trial mixes shall be designed to produce a slump within 3/4 inch of the maximum permitted, and for air-entrained concrete, within 0.5 percent of maximum allowable air content. The temperature of concrete used in trial batches shall not exceed the maximum temperature specified.
    3. For each water-cement ratio, at least three confirmation compression test cylinders for each test age shall be made and cured in accordance with ASTM C192. Confirmation cylinders shall be tested at seven (7) and 28 days in accordance with ASTM C39.

4. From the results of the 28-day confirmation tests, a curve shall be plotted showing the relationship between the water-cement ratio and compressive strengths. From this curve, the water-cement ratio to be used in the concrete shall be selected to produce the average strength required.
5. The cement content and mixture proportions to be used shall be such that this water-cement ratio is not exceeded when slump is the maximum permitted. Control in the field shall be based upon maintenance of proper cement, water content, slump and air content.
6. Mix designs furnished by the concrete supplier, shall be based on the standard deviation analysis of previous test records meeting the requirements of Section 5.3.1 - Standard deviation of ACI 318. These mixes will be accepted in lieu of trial mixtures described in paragraphs above.
    a. Temperature of concrete in test data shall be within 5 degrees F of maximum temperature specified for this project.
    b. Strengths indicated in test data shall be in accordance with ACI 318, Section 5.3.
    c. The specified strength of concrete used in supporting test data shall vary no more than 500 PSI plus or minus from that specified for this project.
    d. The Testing Laboratory shall keep a strength and standard deviation record of all concrete for the duration of the project as specified in this section.

PART 3 - EXECUTION

3.1 GENERAL

A. Inserts: Give the various trades and subcontractors ample notification and opportunity to furnish all anchors, nailers, pipes, conduits, boxes, inserts, thimbles, sleeves, frame vents, wires, supports, or other items required to be built into the concrete by the provisions of the Drawings or of the Specification governing the work of such trades and subcontractors, or as it may be necessary for the proper execution of their work. Obtain suitable templates or instructions for the installation of such items which are required to be placed in the forms.

B. Install under-slab vapor retarder as instructed by manufacturer in accordance with ASTM E1643. Penetrations shall be sealed to maintain integrity of barrier. Tape around all openings and seal all penetrations as instructed by the barrier manufacturer. Grade stakes shall not be driven through the vapor barrier. Avoid punctures during reinforcement and concrete placement.

C. Slump:
1. Concrete not containing a high range water reducing admixture shall not be placed when its plasticity, as measured by slump test, is outside the following limits:
    a. Footings: 6 inches maximum, 4 inches minimum
    b. All other Structural Concrete: 5 inches maximum, 3 inches minimum
    c. Pavement: 4 inches maximum. Coordinate slump with requirements in Section 32 13 13, Concrete Paving.
    d. Slump drop not to exceed 2 inches when pumped.
2. Concrete containing a high range water reducing admixture shall not be placed when its plasticity, as measured by slump test, is outside the following limits:
    a. Prior to addition high range water reducer: 3 inches maximum, 2 inches minimum.
    b. After addition of high range water reducer: 9 inches maximum.

D. Classes of Concrete and Usage: Concrete of the several classes of concrete required shall have the characteristics shown on the Drawings.

E. Mixing:
1. Transit-mixed concrete conforming to the requirements of ASTM C94 and ACI 304 shall be used in lieu of concrete mixed at the job site. Concrete shall not be transported or used in any case after a period in excess of 90 minutes has elapsed after the introduction of water into the mixer.

2. Indiscriminate addition of water to increase slump of concrete is prohibited. Add water only at the direction of the Testing Laboratory. No water shall be added which increases the water cement ratio of the concrete in excess of the water cement ratio indicated on the approved mix design. At the direction of the Inspection and Testing Laboratory the addition of a high range water reducing admixture may be used to retemper concrete.
3. The agency supplying transit-mixed concrete shall have a plant of sufficient capacity and adequate transportation facilities, to assure continuous delivery at the rate required. The frequency of deliveries to the site of the work must be such as to provide for placing the concrete continuously throughout any one (1) pour.

F. Conveying Concrete: Convey concrete from the mixer to the place of final deposit by methods which will prevent the separation or loss of the ingredients. Concrete to be conveyed by pumping shall be submitted to the Inspection and Testing Laboratory for evaluation for each class of concrete specified before being used. Test cylinders for pumped concrete shall be taken at the discharge end of the pumping equipment.

G. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to assure a practically continuous flow of concrete at the delivery end without separation of the materials. The use of gravity-flow or aluminum chutes or conveyors for transporting concrete horizontally will not be permitted.

H. Miscellaneous Materials and Accessories: if not specifically noted, install all materials and accessories per manufacturer's instructions as if noted here in full.

I. Extend underslab vapor barrier continuously under entire slab, slab turn downs, vertical face of grade beams and footings to completely protect concrete adjacent to earth. Overlap joints and install seam tape and pipe boots, and seal penetrations as instructed by manufacturer.

J. Bars shall be supported on chairs or spacers on metal hangers, accurately placed and securely fastened to steel reinforcement in place. No wood or clay brick will be permitted inside forms.

K. All reinforcing shall be set in place, spaced, and rigidly and securely tied or wired at all splices and at all crossing points and intersections.

L. Minimum center to center distance between parallel bars shall be in accordance with the details on the drawings. Where not shown, the clear spacing shall be 1-1/2 times the bar diameter but never less than 1-1/2 inches.

M. Lap of splices where shown and noted on the drawings shall be a minimum of 32 bar diameters but never less than 12 inches.

N. Except where shown on the drawings, minimum concrete coverage for reinforcing steel shall be:
1. 3 inches…where concrete is placed against earth
2. 1-1/2 inches…over column ties
3. 1-1/2 inches…for #5 and smaller bars in formed walls
4. 2 inches…for all bars larger than #5 in formed walls
5. 1 inch…for #11 and smaller bars in suspended slabs
6. 1-1/2 inches…for all bars larger than #11 in suspended slabs

3.2 CONCRETE CONTROL AND TESTING

A. Inspection and Testing laboratory services shall be in accordance with Section 01 45 23, Testing and Inspecting Services.

B. Except as noted below, all inspection and testing related to concrete placement, including reinforcing and embedded items, shall be the responsibility of the Owner. The Owner will directly engage the services of a qualified Testing and Inspection Laboratory, however, the Contractor shall

provide access to the Owner's consultant, and, if required, the Contractor shall provide patching and repairing of surfaces removed to facilitate testing and inspection.

C. Should the strength of concrete fall below the minimum, then additional tests, including load tests, may be required. These tests, if required, shall be made at the Contractor's expense and shall be in accordance with ASTM C42 and ACI 318. If tests do not meet the applicable requirements, then the structure, or any part of the structure, shall be removed and replaced at the Contractor's expense.

D. Any concrete testing requested by the Contractor for early formwork or shoring removal, etc., shall be at the Contractor's expense.

E. Do not permit placement of concrete having a measured slump outside limits given on Drawings or Specifications, except when approved by Architect/Engineer.

3.3 PLACING CONCRETE

A. Place concrete in reasonably uniform layers, approximately horizontal, and not more than 18 inches deep, exercising care to avoid vertical joints or inclined planes. The piling up of concrete in the forms in such a manner as to cause the separation or loss of any of its ingredients will not be permitted. Concrete which has partially set or hardened shall not, under any circumstances, be deposited in the work. All slabs shall be placed for full thickness in one operation without change in proportions, screeded to proper elevation, and floated. Dusting of surfaces with cement is prohibited.

B. Place concrete in the forms as nearly in its final position as is practical to avoid re-handling. Exercise special care to prevent splashing the forms or reinforcement with concrete. Remove any hardened or partially hardened concrete which has accumulated on the forms or reinforcement before the work proceeds. Do not place concrete on previously deposited concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the respective member of section, except as hereinafter specified.

C. Do not permit concrete to drop freely any distance greater than five (5) feet. Where longer drops are necessary, use a chute, tremie, or other acceptable conveyance to assist the concrete into place without separation. Do not pour directly into any excavations where water is standing.

D. Vibration: As soon as concrete is deposited, thoroughly agitate same by means of mechanical vibrators and suitable hand tools, so manipulated as to work the mixture well into all parts and corners of the forms, and entirely around the reinforcement and inserts. Mechanical vibrators shall maintain frequencies in accordance with the recommendations of ACI 309. Table 5.1.4, and shall be operated by competent workmen. Over vibrating and use of vibrators to transport concrete within forms shall not be allowed. A spare vibrator shall be kept on the job site during all concrete placing operations.

E. Bonding: Before depositing any new concrete on or against previously deposited concrete which has partially or entirely set, the surface of the latter shall be thoroughly roughened and cleaned of all foreign matter, scum and laitance. The specified or an Architect approved bonding agent or epoxy adhesive shall be used.

F. Construction Joints: Except as otherwise specifically indicated on the Drawings, each concrete member shall be considered as a single unit of operation, and all concrete for the same shall be placed continuously in order that such unit will be monolithic in construction. Should construction joints prove to be absolutely unavoidable, same shall be located at or near the midpoints of spans. Additional construction joints shall not be made under any circumstances without prior review by the Architect.

Protect all freshly placed concrete from washing by rain, flowing water, etc. Do not allow the concrete to dry out from the time it is deposited in the forms until the expiration of the curing period.

Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at the Contractor's expense and shall be in conformity with all of the requirements of the Contract Documents. Removal and replacement of concrete work shall be done in such a manner as not to impair the appearance or strength of the structure in any way.

G. Cleaning: Upon completion of the work, all forms, equipment, protective coverings and any rubbish resulting therefrom shall be removed from the premises. Finished concrete surfaces shall be left in clean and perfect condition, satisfactory to the Owner. Sweep with an ordinary broom and remove all mortar, concrete droppings, loose dirt, mud, etc.

3.4 FLOOR AND SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
   1. After placing slabs, surface shall be leveled to an F_F 15 - F_L 13 tolerance. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, or sand-bed terrazzo, and as otherwise indicated.
   1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture. Surface shall achieve an F_F 20 - F_L 17 tolerance.

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
   1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final troweling operation, free of trowel marks, uniform in texture and appearance and to a FF35/ FL30 tolerance (FL17 for elevated slabs). Grind smooth surface defects, which would telegraph through applied floor covering system.

D. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps, exterior dugout slabs, and elsewhere as indicated.
   1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application. A sample panel is required.

E. Liquid Densifier/Sealer: Apply liquid densifier/sealer on exposed interior floors subject to vehicular abrasion and as indicated on the Drawings. Compound shall be mechanically scrubbed into the surface in strict accordance with the directions of the manufacturer and just prior to completion of construction.

F. Non-Oxidizing Metallic Floor Hardener: All slabs, in the loading dock area, or other areas noted on the Drawings, shall receive an application of the non-oxidizing, metallic floor hardener applied in accordance with manufacturer's instructions to produce a smooth dense finish.

3.5 NON-SHRINK GROUT

A. Refer to Structural Drawings for column base plates and other structural grouting requirements.

B. Non-shrink grout shall be mixed only in such quantities as are needed for immediate use. No re-tempering shall be permitted and materials which have been mixed for a period exceeding 30 minutes shall in no case be used upon any portion of the work.

C. Where high fluidity and/or increased placing time is required use the specified high flow grout. This grout shall be used for all base plates larger than ten (10) square feet.

D. For every 1/3 cubic yards of grout placed, grout strength shall be tested with a set of cubes as follows:
   1. A set of cubes shall consist of three cubes to be tested seven (7) days, and three (3) cubes to be tested at 28 days.
   2. Test cubes shall be made and tested in accordance with ASTM C1107, Section 12.5, with the exception that the grout should be restrained from expansion by a top plate.

3.6 CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. All concrete shall be kept continuously moist and above 50 degrees F for seven days. When high early strength concrete is used this temperature requirement may be lowered to three (3) days.

B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.
   1. Provide specified curing compound to exposed interior slabs. This curing compound must be dissipating or easily removed in the cleaning process prior to the application of any liquid densifier/ sealer.

3.7 DEFECTIVE WORK

A. Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at the Contractor's expense and shall be in conformity with all of the requirements of the Contract Documents. Removal and replacement of concrete work shall be done in such a manner as not to impair the appearance or strength of the structure in any way.

3.8 CLEANING

A. Upon completion of the work, all forms, equipment, protective coverings and any rubbish resulting therefrom, shall be removed from the premises. Finished concrete surfaces shall be left in clean and perfect condition, satisfactory to the Owner. Sweep with an ordinary broom and remove all mortar, concrete droppings, loose dirt, mud, etc.

3.9 REPAIR OF DEFECTIVE AREAS

A. With prior approval of the Architect/Engineer, as to method and procedure, all repairs of defective areas shall conform to ACI 301, Section 5.3.7, using the polymer repair mortars and/or epoxy adhesives furnished by The Euclid Chemical Company, Sika Chemical Corp., or Architect approved equal.

3.10 FIELD QUALITY CONTROL AND TESTING

A. Inspection and Testing Laboratory services shall be in accordance with Section 01 45 23, Testing and Inspecting Services.

END OF SECTION 03 30 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Suspended slabs.
   5. Concrete toppings.
   6. Building frame members.
   7. Building walls.

B. Related Sections:
   1. Section 01 45 23 “Structural Testing and Inspection Services”.
   2. Section 03 20 00 "Concrete Forming and Accessories".
   3. Section 03 10 00 "Concrete Reinforcing".
   4. Section 03 11 31 “Void Forms”.
   5. Section 03 15 13 “Waterstops”.
   6. Section 03 05 80 “Under-slab Vapor Barrier – Retarder”.
   7. Section 03 47 13 “Tilt Up Concrete”.
   8. Section 31 63 29 “Drilled Concrete Piers and Shafts”.

1.3 REFERENCES

A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
   1. ACI 301 – Specification for Structural Concrete.
   2. ACI 302 – Guide for Concrete Floor Slab Construction.
   3. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete.
   4. ACI 305 – Hot Weather Concreting.
   5. ACI 306 – Cold Weather Concreting.
   6. ACI 308 – Guide to Curing Concrete.
   7. ACI 309 – Guide for Consolidating Concrete.
   8. ACI 311 – ACI Manual for Concrete Inspection.
   9. ACI 318 – Building Code Requirements for Reinforced Concrete.
   10. ACI 347 – Guide to Concrete Formwork.
   11. ACI 207 – Mass Concrete.
   12. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

13. ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
14. ACI 212.3 – Chemical Admixture for Concrete.
15. ACI 212.4 – Guide for the use of High Range Water Reducing Admixtures in Concrete.
16. ACI 214 – Evaluation of Strength Test Results of Concrete.
17. ACI 303 – Guide to Cast in Place Architectural Concrete Practice.
18. Concrete Reinforcing Steel Institute, “Manual of Standard Practice”.

B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture include the following information. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Each proposed mix design shall be accompanied by a complete standard deviation analysis based on at least 30 consecutive strength tests, or by three laboratory trial mixtures with confirmation tests.
2. Proportions of cement, fine, and coarse aggregate, and water.
3. Design strength.
4. Maximum slump.
5. Air Content.
6. Maximum water / cement ratio.
7. Maximum and minimum concrete temperature that is acceptable at time of placement for which the manufacturer can guarantee the strength of the concrete.
8. Type cement and aggregates.
9. Type and quantities of all admixtures.
10. Air dry density and splitting tensile strength for lightweight concrete determined in accordance with ASTM 330.
11. Type, color, and quantities of integral coloring compounds, where applicable.
12. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Refer Section 03 20 00.

D. Formwork Shop Drawings: Refer Section 03 10 00.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Fiber reinforcement.
   4. Curing compounds.
   5. Floor and slab treatments.
   6. Bonding agents.
   7. Adhesives.
   8. Semi rigid joint filler.
   9. Joint-filler strips.
   10. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: See Section 01 45 23.
   1. Contractor’s responsibility to testing laboratory.
      a. Furnish all labor and materials as required to assist testing agency in obtaining, making and handling samples at the jobsite.
      b. Advise the Owner’s Testing Laboratory sufficiently in advance of operations to allow adequate time for the assignment of testing personnel.
      c. Furnish and maintain adequate facilities for proper curing of concrete test specimens on the project site in accordance with ASTM C31.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete."
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
   1. Build panel approximately 200 sq. ft. for slab-on-grade and 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.

H. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. See Section 03 10 00.

2.2 STEEL REINFORCEMENT

A. See Section 03 20 00.

2.3 REINFORCEMENT ACCESSORIES

A. See Section 03 20 00.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I or Type I/II, gray. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F or C. Carbon content shall not exceed 3 percent by volume.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
   1. Maximum Coarse-Aggregate Size: 1-1/2 inches, 1 inch, or 3/4 inch nominal as indicated on Drawings for specific uses.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.

D. Water: ASTM C 94 and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain not more than 0.05 percent water soluble chloride ions. Do not use calcium chloride or admixtures containing calcium chloride (except the chemical admixture Xypex).
   1. Water-Reducing Admixture: ASTM C 494, Type A.
   2. Retarding Admixture: ASTM C 494, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
   7. Waterproofing Admixture: Xypex Admix C-1000

C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ChemMasters.
      b. Davis Colors.
      c. Dayton Superior Corporation.
      d. Hoover Color Corporation.
      e. Lambert Corporation.
      f. QC Construction Products.
      g. Rockwood Pigments NA, Inc.
      h. Scofield, L. M. Company.

i. Solomon Colors, Inc.

2. Color: As selected by Architect from manufacturer's full range.

2.6 FIBER REINFORCEMENT

A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1 to 2-1/4 inches long.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. 3M; Scotchcast Polyolefin Fibers 2".
   b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
   c. FORTA Corporation; FORTA FERRO.
   d. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
   e. Nycon, Inc.; XL.
   f. Propex Concrete Systems Corp.; Fibermesh 650.
   g. Sika Corporation; Sika Fiber MS or MS10.

2.7 CONCRETE MIX DESIGNS

A. Selection of Proportions: Proportions of ingredients for concrete mixes shall be determined by a qualified concrete supplier in accordance with the requirements of ACI 301.

B. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. Calculation of standard deviation of compressive strength results shall be made in accordance with ACI 214. If a suitable record of strength tests is not available, proportions shall be selected on the basis of laboratory trial batches to produce an average strength greater than the strength f’c by the amount defined in ACI 301.

2.8 VAPOR RETARDERS

A. See Section 03 05 80.

2.9 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 sieve.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Anti-Hydro International, Inc.; Emery.
   b. Dayton Superior Corporation; Emery Tuff Non-Slip.
   c. Lambert Corporation; EMAG-20.
   d. L&M Construction Chemicals, Inc.; Grip It.
   e. Metalcrete Industries; Metco Anti-Skid Aggregate.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Anti-Hydro International, Inc.; A-H Alox.

b. L&M Construction Chemicals, Inc.; Grip It AO.
c. Master Builders Solutions; MasterTop 120SR (Pre-2014: Frictex NS)

2.10 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate 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 siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Advanced Floor Products; Retro-Plate 99.
b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.11 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
b. ChemMasters; SprayFilm.
c. Conspec by Dayton Superior; Aquafilm.
d. Dayton Superior Corporation; Sure Film (J-74).
e. Edoco by Dayton Superior; BurkeFilm.
f. Euclid Chemical Company (The), an RPM company; Eucobar.
g. Kaufman Products, Inc.; Vapor-Aid.

h. Lambert Corporation; LAMBCO Skin.
i. L&M Construction Chemicals, Inc.; E-CON.
j. Master Builders Solutions; MasterKure ER 50 (Pre-2014: Conflim).
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. ChemMasters; Safe-Cure Clear.
c. Conspec by Dayton Superior; W.B. Resin Cure.
d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
e. Edoco by Dayton Superior; Res X Cure WB.
f. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; AQUA KURE - CLEAR.
i. L&M Construction Chemicals, Inc.; L&M Cure R.
j. Meadows, W. R., Inc.; 1100-CLEAR.
k. Nox-Crete Products Group; Resin Cure E.
l. Right Pointe; Clear Water Resin.
m. SpecChem, LLC; Spec Rez Clear.
n. Symons by Dayton Superior; Resi-Chem Clear.
o. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. Products: Subject to compliance with requirements, provide one of the following:
a. ChemMasters; Polyseal WB.
b. Conspec by Dayton Superior; Sealcure 1315 WB.
c. Edoco by Dayton Superior; Cureseal 1315 WB.
d. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.

e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
f. Lambert Corporation; UV Safe Seal.
g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
h. Master Builders Solutions; MasterKure CC 1315WB (Pre 2014: Kure1315).
i. Meadows, W. R., Inc.; Vocomp-30.
j. Metalcrete Industries; Metcure 30.
k. Right Pointe; Right Sheen WB30.
l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.12 RELATED MATERIALS

A. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.14 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, as indicated in Structural General Notes.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
   4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 NON-SHRINK GROUT

A. Grout shall be prepackaged, non metallic, and non gaseous. It shall be non-shrink when tested in accordance with ASTM-C1107 Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through the flow cone after slight agitation, in temperatures of 40 degrees to 90 degrees Fahrenheit. Grout shall be bleed free and attain 7,500 psi compressive strength in 28 days at fluid consistency. Certified independent test data required. Approved products include the following:
   1. “Euco NS” by Euclid Chemical Company
   2. “Masterflow 713” by Master Builders.

2.16 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion normal-weight concrete mixture as indicated in Structural General Notes:

2.17 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.18 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. See Section 03 10 00.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   2. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. See Section 03 10 00.

3.4 SHORES AND RESHORES

A. See Section 03 10 00.

3.5 VAPOR RETARDERS/BARRIERS

A. See Section 03 05 80.

3.6 STEEL REINFORCEMENT

A. See Section 03 20 00

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
   6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are specified or otherwise indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Do not permit concrete to drop freely any distance greater than 10’-0” for concrete containing a high range water reducing admixture or 5’-0” for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

H. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

A. See Section 03 10 00.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, 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 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.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
   1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
   2. After broadcasting and tamping, apply float finish.
   3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive granules.

3.11 CONCRETE FLOOR FINISH TOLERANCES

A. Interior Finish Floor surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." The following values apply before removal of shores. Levelness values F(L) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
   1. Exposed, vinyl tiled, or thin-set tiled floors: Specified overall values of flatness, Ff =35; and levelness, 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.
      a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer’s written instructions.
   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than 28 days' old.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
   1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
   2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
   3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
   4. Control and dispose of waste products produced by grinding and polishing operations.
   5. Neutralize and clean polished floor surfaces.

C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's

written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: See Section 01 45 23.
1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
2. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
NOTE: Add articles for flowable fill in products and execution. NEEDS RESEARCH.

END OF SECTION 03 30 00

SECTION 03 35 00 - CONCRETE FINISHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Liquid densifiers and hardeners.

B. Related Sections
   1. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.3 REFERENCE STANDARDS

A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010.

B. ACI 301 - Specifications for Concrete Construction (ACI 301-20); 2020 Edition, September 2020.

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2015.

D. ACI 305R - Guide to Hot Weather Concreting; September 2020.

E. ACI 306R - Guide to Cold Weather Concreting; 2016 Edition, September 2016.

F. ACI 318 - Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19); 2019 Edition, June 2019.

G. ACI PRC-302.2 - Concrete Slabs that Receive Moisture-Sensitive Flooring Materials-Guide; 2023.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

C. Product Data: Manufacturer's published data and installation instructions for concrete polishing system and finishing products, including manufacturer's installation instructions, information on compatibility of different products, and limitations.

D. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

E. Warranty Documentation: Manufacturer warranty; ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Specimen Warranty: Manufacturer warranty.

1.6 QUALITY ASSURANCE

A. For slabs indicated to receive concrete polishing system, do not proceed with concrete polishing unless manufacturer's representative and specialized equipment is present for every day of placement.

1.7 MOCK-UP

A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.

B. Mock-Up Size: 10 feet (3 m) square.

C. Locate where directed by the Architect.

D. Mock-up may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.9 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.

B. Do not finish floors until interior heating system is operational.

C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

1.10 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

B. Correct defective work within a two-year period commencing on the Date of Substantial Completion.

C. Manufacturer's Warranty: Provide two-year manufacturer warranty commencing on the Date of Substantial Completion.

D. Installer's Warranty: Provide two-year manufacturer warranty commencing on the Date of Substantial Completion.

E. Finish Warranty: Provide five-year manufacturer warranty against excessive degradation of finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Adhesives Technology Corporation: www.atcepoxy.com.
   2. Euclid Chemical Company: www.euclidchemical.com.
   3. PROSOCO, Inc.: www.prosoco.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Concrete Standards:
      a. American Concrete Institute (ACI) Publications: (Standards):
         1) Comply with the following unless modified by requirements in the Contract Documents:
            (a) ACI 117, "Specification for Tolerances for Concrete Construction and Materials and Commentary."
            (b) ACI 301, "Specifications for Structural Concrete."
            (c) ACI 302.1R, "Guide to Concrete Floor and Slab Construction."
            (d) ACI PRC-302.2, "Guide for Concrete Slabs that receive Moisture-Sensitive Flooring Materials."
            (e) ACI 305R, "Guide to Hot Weather Concreting."

(f) ACI 306R, “Guide to Cold Weather Concreting.”
(g) ACI 318, “Building Code Requirements for Structural Concrete and Commentary.”

2.3 CONCRETE FLOOR FINISH APPLICATIONS

A. Typical Concrete Finishing:
   1. Unless otherwise indicated, all exposed concrete floors are to be finished using liquid densifier and hardener.

2.4 DENSIFIERS AND HARDENERS

A. Liquid Densifier and Hardener: Penetrating chemical compound that reacts with concrete, filling the pores, hardening, and dustproofing.
   1. Composition: Lithium silicate.
   2. Basis of Design Product:
      a. Pentra-Pel (SI) manufactured by Adhesives Technology Corporation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.2 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.3 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION 03 35 00

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SECTION 03 52 16 - LIGHTWEIGHT INSULATING CONCRETE DECK SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. It is the intent of this Section,
   1. to include the lightweight insulating concrete, and EPS roof insulation for all areas of existing roof construction, and
   2. that all Work be performed by the lightweight insulating concrete Sub-contractor.

1.2 RELATED WORK

A. All Sections of Work pertinent to the roofing system, including mechanical, plumbing and electrical items penetrating metal deck, lightweight insulating concrete, rough carpentry, roof insulation, subsequent roofing and sheet metal flashing and trim.

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications, instructions and other data needed for proper placement of the lightweight insulating concrete roof insulation system.
   2. Manufacturer's installation instructions.

B. Mix Design: Indicate materials and proportions of proposed mix.

C. Applicator’s Qualifications: Submit a letter from the proposed lightweight insulating concrete system supplier confirming that the Contractor is approved to install the proposed lightweight insulating concrete system. Refer also to Paragraph 1.5, A.

D. Certifications:
   1. Manufacturer’s affidavit that materials used in Project contain no asbestos.
   2. On completion of installation, furnish Architect with Certificate signed by a representative of the manufacturer and by the applicator stating that insulating concrete was prepared and applied in accordance with manufacturer's recommendations.
   3. Manufacturer’s certification that system meets or exceeds UL-90 wind up-lift and UL Class A fire rating.
   4. Manufacturer’s certification that system meets or exceeds Factory Mutual Research Corp. FM I-90 wind up-lift rating.

E. Warranty:
   1. Submit a sample copy of the warranty covering the proposed lightweight insulating concrete system.
   2. Submit a sample copy of the roof system warranty covering the proposed lightweight insulating concrete system and roof membrane system.
   3. Refer to the roofing system specification section and coordinate the lightweight insulating concrete system warranty with the roof system warranty.

1.4 REFERENCES

A. Comply with all applicable recommendations of the referenced standards. In any conflict between referenced standards, the more stringent requirements shall govern.
   1. American National Standards Institute/Underwriters’ Laboratories, Inc. (ANSI/UL)

2. American Society for Testing and Material (ASTM)
   a. A525, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   b. C150, Standard Specification for Portland Cement
   c. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
   d. C332, Standard Specification for Lightweight Aggregates for Lightweight Concrete
   e. C495, Standard Test Method for Compressive Strength of Lightweight Insulating Concrete
   f. E119, Standard Test Methods for Fire Tests of Building Construction and Materials
3. National Roofing Contractors Association (NRCA)
4. Occupational Safety and Health Administration (OSHA)
5. Underwriters' Laboratories, Inc. (UL)
   a. Wind Uplift Class 90 - UL-90
   b. Fire Ratings - Class A
6. Vermiculite Association (VA)

1.5 QUALITY ASSURANCE

A. Applicator:
   1. A firm regularly engaged in and properly equipped for the installation of lightweight fill, and acceptable to the fill manufacturer, which has installed at least five (5) million square feet in the last five (5) years.
   2. Key Person Requirement: A thoroughly trained and experienced employee of the Installer, who is acceptable to the Roofing Consultant, shall be present at all times during the execution of work specified in this Section, and direct that work.
   3. Approved in writing by manufacturer to install the roof lightweight insulating concrete deck system.
   4. Responsible for ensuring positive drainage.
   5. **No ponding** water will be acceptable.
   6. Perform water test prior to application of roof system. Architect will be present, provide 48 hours' notice in advance of water testing.

B. Agency Approvals: Provide products, execution, and material thickness to conform to the applicable code requirements for the required fire resistance ratings, wind uplift classifications, insulation values, and diaphragm values.

C. Diaphragm Construction: Incorporate metal decking thickness, welding pattern, and minimum compressive strength of the lightweight insulating concrete to achieve diaphragm design values for edge and field conditions as specified to meet applicable code requirements.

D. Fire Resistance Classifications: Provide a lightweight insulating concrete system meeting the following fire resistance standards:
   1. Tested by UL in accordance with the procedures of ASTM E119 and listed in the UL "Fire Resistance Directory".
   2. Approval Rating: Class A

E. Wind Uplift Classifications: Provide a lightweight insulating concrete system meeting the following wind uplift standards:
   1. Tested by UL in accordance and listed in the UL "Roofing Materials Directory" for wind uplift resistance.
   2. Approval Rating: UL-90
   3. Tested and approved by Factory Mutual Research Corp. for wind up-lift rating of I-90.

F. Inspection and Testing Laboratory Services:
   1. Test results shall meet or exceed established Standards. Refer to Section 01115, Inspection and Testing Laboratory Services.
   2. The Owner will select the Inspection and Testing Laboratory and pay for the cost of tests to determine the dry density and compressive strength.
   3. Compressive strength shall be determined in accordance with ASTM C495.
   4. Wet and dry density range shall be in accordance with ASTM C495.
   5. Polystyrene (EPS) density shall be in accordance with ASTM C578.

G. Building / Construction Components: Meet or exceed established standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened packaging fully identified as to manufacturer, brand or other identifying data as approved in submittal documents.

B. Store materials under cover, and in a dry location until ready for installation. Roofing insulation must always be covered or stored in a dry area when not being used.

C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload the structure.

D. Familiarize every member of the installation crew with the manufacturer’s material safety data sheets and with fire and safety regulations recommended by OSHA, NRCA, and as required by governing codes of authorities having jurisdiction.

1.7 PROJECT / SITE CONDITIONS

A. When air temperatures of 40 degrees F or above are predicted to occur within the first 24 hours after placement, normal application procedures may be used.

B. When air temperatures of 32 degrees F - 40 degrees F are predicted to occur within the first 24 hours after placement, warm water not exceeding 90 degrees F may be used.

C. Do not place the lightweight insulating concrete system when air temperatures are below 40 degrees F, including wind chill.

D. Insulating Lightweight Concrete Fill Installer shall be responsible for protecting the new insulating lightweight concrete deck from all adverse conditions until roofing begins.

1.8 SEQUENCING AND SCHEDULING

A. Sequence and coordinate application of lightweight insulating concrete roof insulation with work in other sections so as not to interfere with efficient roof insulation application.

1.9 WARRANTY

A. Manufacturer’s Warranty: Warrant the decking and associated Work in conjunction with the roofing manufacturer from the project date of Substantial Completion as follows:
   1. The warranty shall be a NDL “No Dollar Limit” / no penal sum type, with total replacement cost. Refer to roof system specification section for length of warranty period.
   2. The warranty shall provide manufacturer’s maximum extended wind rated coverage (up to Hurricane force winds) as defined by the Beaufort Scale.

3. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
4. The full system warranty including lightweight insulating concrete deck, roofing insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.

B. Contractor Warranty: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the lightweight insulating concrete deck will be and remain in good condition for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty.

C. Make arrangements with the roofing manufacturer to provide the required warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Products and manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
1. Elastizell Corp. of America
2. Siplast, Inc.
3. Vermiculite Products Inc.
4. Celcore, Inc.
5. Mearlcrete

2.2 MATERIALS

A. Metal Deck: Refer to Section 05 31 00. Corrugated steel decking incorporating a pre-applied galvanized coating conforming to ASTM A653, minimum Class G-90 and having slots in flutes equal to a minimum of 0.75 percent of the deck area. Refer to Structural Drawings for size, type and section modulus of metal deck and for welding pattern of deck.

B. Insulation Board:
1. Type: Expanded polystyrene (EPS) insulation board Type I by ASTM C578 and containing approximately three (3) percent open area.
2. Thickness: 6 inches thick minimum, unless shown otherwise.
3. Approved Products / Manufacturers:
   a. "Insulperm" manufactured by Siplast, Irving, Texas (800) 922-8800.
   b. “Starrfoam-HB” manufactured by Starrfoam Manufacturing, Inc., Fort Worth, Texas (817) 654-4688.
   c. “Vermaperm” manufactured by Vermiculite Products Inc., Houston, Texas (713) 869-6663.
   d. “Holey Board” manufactured by Houston Foam Plastics, Houston, Texas, (713) 224-3612.

C. Water: Potable water that is clean and free of deleterious amounts of acid, alkali, and organic materials – (Drinkable).

D. Cement: Portland type, conforming to ASTM C150, Type I or III.

E. Foam Concentrate: Protein based foam concentrate conforming to ASTM C 869 and ASTM C 796.

F. Vermiculite Aggregate: Any one (1) of the following products from a single manufacturer is approved for use on this Project:
   1. Vermiculite: Comply with ASTM C332, produced by a current member of VA. Mix shall be 1:6 with 300 (min) psi at 28 days compressive strength; 48 to 60 pcf wet density, and 25 to 32 pcf dry density.
   2. Cellular: Mix shall be 1:3 with minimum compressive strength of 300 psi, cast density of 34-42 pcf, manufactured by Elastizell Corporation of America, Ann Arbor, MI (734) 761-6900\

G. Admixtures: Air entraining types and superplacticizer (water reducer) types as recommended by insulating concrete material manufacturer. Admixtures may be injected into material at the plant. The use of calcium chloride is not permitted.

H. Expansion Joint Material: One (1) inch thick of type recommended by insulating concrete material supplier for expansion joints in structural system.

I. Reinforcing: 3/4 inch long, polypropylene fiber, Fibermix as manufactured by Fibermesh Co. for cellular concrete only.

J. Nailers: (Refer to Section 06 10 00, Rough Carpentry) As shown on drawings. Install required thickness of wood to align with specified thickness of lightweight insulating concrete.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to placing reinforcing and insulating concrete, inspect to ensure all piping, curbs, wood nailers, etc., have been raised to the proper height and the substrate is free of any foreign materials.

B. Ensure perimeter edge and penetrations are sealed in a watertight fashion.

C. Ensure temporary roof is installed as specified in Section 07 52 19.

3.2 PREPARATION

A. Notify other trades of dates of pouring in ample time for each to install his work.

B. Review required finishes and allowable tolerances for surface defects.

C. Set screeds so various deck thicknesses are maintained uniformly in place with all slopes as shown and detailed on drawings.

D. Verify with the appropriate type instrument that all roof areas have positive drainage. Areas lacking positive drainage are unacceptable and shall be removed and re-poured at Contractor's expense.

3.3 INSTALLATION

A. Metal Deck: Place sheets with corrugation edges upon the perpendicular to supports with end laps centered over supports. Attach to supports with plug welds through welding washers. Refer to Structural Drawings for additional requirements.

B. Expansion Joint Material: Install at the following locations.
   1. Perimeter of deck.
   2. Changes in direction of roof deck.
   3. Structural roof penetrations and expansion joints

C. Provide equipment and installation procedures conforming to the materials manufacturer's installation instructions.

D. Mix Portland cement and aggregate in a mix ratio design with water in accordance with manufacturer's instructions to achieve the specified wet density, minimum dry density, and minimum compressive strength.

E. Install slurry coat of lightweight insulating concrete over metal deck to minimum thickness of 1/4 inch over top of flutes of metal decking.

F. Place insulation boards into slurry within 30 minutes of applying lightweight insulating concrete in accordance with manufacturer's instructions.

G. Place insulation board with joints staggered in a brick-like running bond pattern.

H. Hold board back two (2) inches from the perimeter of the roof areas and all roof top units.

I. Butt boards together and place so as to provide full contact of slurry with board, causing insulating concrete fill to enter the locking/keying openings in the insulation board.

J. Walk insulation board into slurry to ensure proper embedding of insulation boards into lightweight insulating concrete and keying with insulation holes.

K. Fill holes in the insulation boards and place a two (2) inch minimum thickness of lightweight insulating concrete over top of the insulation boards within four (4) hours after installation of insulation boards.

L. Build all crickets and saddles shown with lightweight insulating concrete sloped to drain as indicated on drawings.

M. Deposit insulating concrete fill and screed (without troweling, rodding, tamping, or vibrating) immediately after mixing. Place on surfaces clean and free of loose material. Place no concrete when temperature is 40 degrees F or falling.

N. All wood blocking for deck penetrations support and low roof deck to rise wall blocking shall be installed one (1) inch higher than designed lightweight fill thickness. Install fill in a two (2) foot tapered edge condition.

O. Allow insulating concrete fill to dry as thoroughly as possible before application of roofing, and not less than the minimum time recommended by the manufacturer. Begin roofing when the insulating concrete fill can withstand construction traffic (usually two (2) to three (3) days after placement), verify / confirm with manufacturer's recommendations. Do not leave insulating concrete fill deck surface exposed for longer than ten (10) days. Install no more insulating concrete fill than can be roofed within the ten (10) day time limit. Maximum unroofed insulating concrete deck shall be 5,000 square feet; no exceptions.

P. Where material is to be pumped, equipment shall be in good condition and well maintained to avoid equipment failure and delays.

Q. Install and cure lightweight insulating concrete in accordance with manufacturer's instructions.

R. Avoid roof-top traffic over the lightweight insulating concrete deck system until 24 hours have elapsed after last placement of lightweight insulating concrete.

S. Allow lightweight insulating concrete to dry as thoroughly as possible before application of roofing. Testing Laboratory may perform tests to determine moisture content of lightweight insulating concrete.

T. Add two (2) pounds of fiber reinforcing per cubic yard of lightweight insulating concrete if cellular concrete is used.

3.4 FIELD QUALITY ASSURANCE

A. The Owner will select the independent inspection and testing laboratory and pay for the cost of tests in accordance with Division 1.

B. The independent inspection and testing laboratory will randomly sample and verify the following:
1. Thermal insulation value in accordance with ASTM C177.
2. Mix design compressive strength in accordance with ASTM C495.
3. Mix design wet and dry density range in accordance with ASTM C495.
4. Polystyrene insulation density in accordance with ASTM C578.

C. Contractor shall provide base ply fastener pull tests prior to installation of roofing system, following the installation of the lightweight insulating concrete to ensure a minimum withdrawal resistance of 40 pounds per fastener.

D. Results of all tests will be made available to all concerned parties.

E. Water Test: Run water on the finished deck for the Architect's observation. The lightweight insulating concrete shall slope to drain and no ponding of water will be accepted. No slopes less than 1/4 inch per foot will be allowed.

F. Certification: On completion of installation, furnish Architect with certificate signed by a representative of the manufacturer and by the applicator stating that insulating concrete was prepared and applied in accordance with manufacturer's recommendations.

3.5 ADJUSTING AND CLEANING

A. Remove ridges, surface depressions and other surface irregularities which are unacceptable to the roofing contractor and Architect.

B. Completely remove all insulating concrete fill from any surface on which it is not intended to be placed.

C. Perform all patching and repairing of insulating concrete using Zono-Patch or other materials approved by the lightweight insulating concrete supplier.

3.6 PATCHING AND REPAIRING

A. Perform all patching and repairing of lightweight insulating concrete using the same materials specified in this Section or materials approved by the system manufacturer.

B. The party responsible for damage will be charged for repairs.

3.7 PROTECTION

A. Lightweight insulating concrete installer shall be responsible for protecting newly applied decks from all adverse conditions until Roofing Contractor begins installation of specified roof system.

B. General Contractor shall be responsible for protection of roof deck from other trades until it has been approved for traffic by installer.

END OF SECTION

SECTION 04 05 00 - COMMON WORK RESULTS FOR MASONRY

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section includes:
   1. Mortar and grout for masonry assemblies.
   2. Ties and anchors.
   3. Embedded flashing.
   4. Penetrating water repellents.
   5. Miscellaneous masonry accessories.
   6. Cleaning exposed unit masonry surfaces.

B. Related Sections:
   1. Section 04 01 20 - Maintenance of Unit Masonry: Cleaning of Masonry.
   2. Section 05 50 00 - Metal Fabrications: Steel embeds and lintels.
   3. Section 07 92 00 - Joint Sealants: Sealants for control and expansion joints.

1.3 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2024b.

C. ASTM A580/A580M - Standard Specification for Stainless Steel Wire; 2018.

D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

E. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.

F. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2016.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

H. ASTM B32 - Standard Specification for Solder Metal; 2020.

I. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2022.

J. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.

K. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.

L. ASTM C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement; Current Edition.

M. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

N. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

O. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

P. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

Q. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

R. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

S. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.

T. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

U. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.

V. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).

W. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber; 2020.

X. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.

Y. ASTM D2287 - Standard Classification System and Basis for Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds; Current Edition.

Z. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.4 DEFINITIONS

A. Very Low Pressure Spray: Under 100 psi (690 kPa).

B. Low Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Mix design for mortar and grout shall be submitted for review.

C. Supplier’s certificates indicating materials comply with the specifications below. They shall include, but are not necessarily limited to:
   1. Aggregates.
   2. Cement.
   3. Admixtures.

D. Shop Drawings:
   1. For the following:
      a. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

E. Samples for Initial Selection:
   1. Colored mortar.
   2. Weep holes/vents.

F. Samples for Verifications:
   1. For each type and color of the following:
      a. Pigmented and colored-aggregate mortar. Make samples using same sand and mortar ingredients to be used on Project.
      b. Weep holes and vents.
      c. Accessories embedded in masonry.

G. Material Certificates:
   1. For each type and size of the following:
      a. Cementitious materials. Include brand, type, and name of manufacturer.
      b. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
      c. Grout mixes. Include description of type and proportions of ingredients.

d. Anchors, ties, and metal accessories.

H. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

B. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 - Project Management and Coordination.

C. Tests and Inspections:
1. All tests and inspections herein are to be performed by an independent testing laboratory approved by the building official.
2. Mortar and Grout Tests:
a. At the beginning of masonry work, at least one test sample each of mortar and grout shall be taken on three successive working days, then once per week with at least one sample taken for each 5,000 sq. ft. (465 sq. m) of wall area, or fraction thereof:
1) Test specimens shall be made in accordance with ASTM C1019 for grout and ASTM C780 for mortar.
2) Test specimens shall be continuously stored in moist air until tested.
3) Mortar shall show a compressive strength of not less than 1,800 psi at 28 days. Grout shall show a compressive strength of not less than 2,000 psi at 28 days.

D. Paint Remover Manufacturer Qualifications: Firm having minimum five years' documented experience who regularly engages in producing masonry cleaners, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.

E. Chemical Cleaner Manufacturer Qualifications: Firm having minimum five years' documented experience who is regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.

F. Cleaning Program:
1. Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage:
a. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness.

G. Pre-Installation Conference:
1. Conduct conference at Project site:
a. Verify masonry cleaning equipment and facilities needed to make progress and avoid delays.
b. Materials, material application, and sequencing.
c. Cleaning program.
d. Coordination with building occupants.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.2 MORTAR AND GROUT MATERIALS

A. Portland Cement
   1. ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
      a. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

B. Hydrated Lime:
   1. ASTM C207, Type N or S as indicated in masonry section.

C. Portland Cement-Lime Mix:
   1. Packaged blend of Portland cement and hydrated lime,complying with specified requirements and containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Quicklime: ASTM C5.

F. Lime Putty:
   1. Made from hydrated lime or quicklime:
      a. If made from quicklime, other than processed pulverized quicklime, slake lime and then screen through a No. 16 mesh sieve. Before using, store and protect slaked and screened lime putty for not less than 10 days.
      b. Processed pulverized quicklime shall be slaked for not less than 48 hours, and shall be cool when used.
      c. Lime putty prepared from hydrated lime may be used immediately after mixing.
      d. Lime putty prepared from quicklime or pulverized quicklime shall have a plasticity figure, after slaking and screening, of not less than 200, and shall weigh not less than 83 pounds per cubic foot. Lime putty prepared from hydrated lime shall conform to ASTM C207, Type S.

G. Aggregate:
   1. For mortar: ASTM C144.
   2. For grout: ASTM C404.

H. Admixtures:
   1. Water Repellent Admixture:
      a. Liquid water repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer:
         1) Manufacturers:

(a) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
(1) BASF Corporation; Construction Systems: www.basf.com.
(2) Euclid Chemical Company (The); an RPM company: www.euclidchemical.com.
(3) GCP Applied Technologies: www.gcpat.com.
(b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
(1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

I. Mortar Pigments:
1. Natural and synthetic iron oxides and chromium oxides compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar:
a. Manufacturers:
1) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
(a) Davis Colors: www.davoscolors.com.
(b) Lanxess Corporation: www.lanxess.com/en..
(c) Solomon Colors, Inc.: www.solomoncolors.com.
2) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
(a) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

J. Water: Potable.

2.3 MORTAR MIXES

A. General:
1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated:
a. Do not use calcium chloride in mortar.
b. Use masonry cement or mortar cement mortar unless otherwise indicated.
c. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Pre-Blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
1. Manufacturers
a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1) E-Z Mix, Inc.: www.ezmixinc.com.
b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
2. Basis of Design :
a. SPEC MIX Preblended Mortar Mix manufactured by E-Z Mix, Inc.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide Type S or Type N as indicated in related Section.
   1. Type S mortar shall have a 28 day compressive strength of not less than 1,800 psi (12.4 MPa).

D. Pigmented Mortar:
   1. Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products:
      a. Pigments shall not exceed ten percent of portland cement by weight.
      b. Pigments shall not exceed five percent of masonry cement or mortar cement by weight.

E. Colored-Aggregate Mortar:
   1. Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color:

F. Mortar shall be made with admixtures that are proportioned, added and mixed in strict accordance with manufacturer's directions.

G. Mortar mix shall be proportioned by volume; one-part portland cement, not less than 1/4 part nor more than 1/2 part lime putty, and sand totaling not less than 2-1/4 nor more than 3 times sum of volumes of cement and lime used:
   1. Total clay content shall not exceed 2 percent of sand content or six percent 6 percent of cement content.

2.4 GROUT MIXES

A. Grout for Unit Masonry: Comply with ASTM C476.
   1. Grout shall have a 28-day compressive strength of not less than 2,000 psi (13.7 MPa). Proportion by volume and with sufficient water to produce consistency for pouring without segregation so that grout will flow into masonry joints.
   2. Proportion by volume and with sufficient water to produce consistency for pouring without segregation so that grout will flow into masonry joints.

B. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that complies with TMS 402/602 for dimensions of grout spaces and pour height.
   1. Fine Grout:
      a. One-part portland cement, to which may be added not more than 1/10 part lime putty, and 3 parts sand.
      b. Fine grout shall be used for all grout spaces less than 3 inches (76 mm) wide.
   2. Coarse Grout:
      a. One-part portland cement, to which may be added not more than 1/10 part lime putty, 3 parts sand, and not less than one-part nor more than two-parts pea gravel (3/8 inch (10 mm) maximum aggregate size).
      b. Coarse grout shall be used in grout spaces 3 inches (76 mm) wide or more.

C. Grout Additive:

2.5 REINFORCEMENT

A. Masonry Joint Reinforcement, General: ASTM A951/A951M.
   1. Masonry joint reinforcement used in exterior walls shall be hot-dipped galvanized, conforming to ASTM A153/A153M, Class B, minimum coating of 1.5 ounce for square foot.

B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187 inch (4.7 mm) diameter, hot-dip galvanized, carbon-steel continuous wire.

C. Reinforcing Bars:
   1. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).

D. Reinforcing Bar Positioners:
   1. Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Form units from 0.148 inch (3.77 mm) steel wire, hot dip galvanized after fabrication. Provide units designed for number of bars indicated:
   2. Manufacturers:
      a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
         1) Heckmann Building Products, Inc.: www.hechmanbuildingproducts.com.
         2) Hohmann & Barnard, Inc.: www.h-b.com.
         3) Wire-Bond: www.wirebond.com.
      b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
         1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.6 TIES AND ANCHORS

A. General:
   1. Sheet Metal Anchors and Ties - ASTM A1008/A1008M:
      a. Sheet metal anchors and ties used in exterior walls shall be hot-dipped galvanized, conforming to ASTM A153/A153M, Class B.

B. Wire Ties and Anchors:
   1. General:
      a. Provide ties and anchors made from materials complying with the following unless otherwise indicated:
         1) Stainless Steel Wire: ASTM A580/A580M, Type 306.
   2. Individual Wire Ties:
      a. W-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inch (50 mm) long.
      b. Wire: Fabricate from #9 AWG corrosion resistant wire.

2.7 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034 inch (0.9 mm) galvanized steel sheet.

2.8 EMBEDDED FLASHING MATERIALS

A. Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and/or Section 07 62 00 - Roof Related Sheet Metal and as follows:
   1. Stainless Steel: ASTM A240/A240M, Type 304, 0.016 inch (0.4 mm) thick.
   2. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16 oz. / sq. ft. (4.9 kg / sq. m) weight or 0.0216 inch thick or ASTM B370, Temper H01, high-yield copper sheet, 12 oz. / sq. ft. (3.7 kg / sq. m) weight or 0.0162 inch (0.41 mm) thick.
   3. Fabricate continuous flashings in sections 96 inches (2,438 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
   4. Fabricate through-wall metal flashing embedded in masonry from copper, with ribs at 3 inch (76 mm) intervals along length of flashing to provide an integral mortar bond:
      a. Manufacturers:
         1) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
            (a) Cheney Flashing Company: www.cheneyflashing.com.
            (b) Keystone Flashing Company, Inc: www.keystoneflashing.com.
         2) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

(a) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

b. Basis of Design Products:
1) Cheney Flashing (Dovetail) manufactured by Cheney Flashing Company.
2) Keystone 3-Way Thruwall Flashing manufactured by Keystone Flashing Company, Inc: .

5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
6. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
7. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
8. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inch (76 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
9. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inch (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
10. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inch (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
11. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Flexible Flashing:
1. Use one of the following unless otherwise indicated:
a. Copper-Laminated Flashing: 5 oz. / sq. ft. (1.5 kg / sq. m) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry:
1) Manufacturers:
(a) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
(1) Hohmann & Barnard, Inc.: www.h-b.com.
(b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
(1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
2) Basis of Design Products:
(a) Products manufactured by Hohmann & Barnard, Inc.
b. Asphalt-Coated Copper Flashing: 7 oz. per sq. ft. (2.1 kg per sq. m) copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry:
1) Manufacturers:
(a) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
(1) Advanced Building Products Inc.: www.advancedbuildingproducts.com.
(2) Hohmann & Barnard, Inc.: www.h-b.com.
(b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

(1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2) Basis of Design Products :
   (a) Products manufactured by Advanced Building Products Inc.
   (b) Products manufactured by Hohmann & Barnard, Inc.
3) Accessories:
   (a) Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Application:
   1. Unless otherwise indicated, use the following:
      a. Where flashing is indicated to receive counterflashing, use metal flashing.
      b. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
      c. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge with a sealant stop or flexible flashing with a metal sealant stop.
      d. Where flashing is fully concealed, use flexible flashing.

D. Solder and Sealants for Sheet Metal Flashings:
   1. Solder for stainless steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
   2. Solder for copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 LIQUID SURFACE TREATMENTS

A. Penetrating Water Repellent:
   1. Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components, odorless, that penetrates, hardens, and densifies concrete surfaces:
   2. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
   3. Manufacturers:
      a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
         1) Moxie International Inc.: www.moxieshield.com.
      b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
         1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
   4. Basis of Design Product:

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane.

B. Preformed Control Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-

65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

D. Weep/Vent Products - Use one of the following unless otherwise indicated:
   1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 inch (6 mm) to 3/8 inch (10 mm) in diameter, in length required to produce 2 inches (51 mm) exposure on exterior and 18 inches (457 mm) in cavity. Use only for weeps.
   2. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8 inch (10 mm) OD by 4 inches long.
   3. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 inch (10 mm) by 1-1/2 inches (38 mm) by 3-1/2 inches (89 mm).
   4. Mesh Weep/Vent:
      a. Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard:
      b. Manufacturers:
         1) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
            (a) Mortar Net Solutions: www.mortarnet.com.
         2) Substitutions:Refer to Section 01 25 13 - Product Substitution Procedures.
            (a) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

E. Cavity Drainage Material:
   1. Free draining mesh, made from polymer strands that will not degrade within the wall cavity.
   2. Manufacturers:
      a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
         1) Advanced Building Products Inc.: www.advancedbuildingproducts.com.
         2) Heckmann Building Products, Inc.: www.heckmannbuildingprods.com.
         3) Hohmann & Barnard, Inc.: www.h-b.com.
         4) Mortar Net Solutions: www.mortarnet.com.
         5) Wire-Bond: www.wirebond.com.
      b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
         1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
   3. Configuration:
      a. Strips, full depth of cavity and 10 inches (254 mm) high, with dovetail shaped notches 7 inches (178 mm) deep that prevent clogging with mortar droppings.

2.11 CLEANING MATERIALS

A. Water:
   1. Potable.

B. Hot Water:
   1. Water heated to a temperature of 140 to 160 degrees F (60 to 71 degrees C).

C. Detergent Solution, Job Mixed:

D. Mold, Mildew, and Algae Remover, Job Mixed:

1. Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 qt (5 L) of five percent sodium hypochlorite (bleach), and 15 qt (15 L) of hot water for every 20 quarts (19 L) of solution required.

E. Non-Acidic Gel Cleaner:
   1. Gel formulation, with pH between 6 and 9 that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces:
   2. Manufacturers:
      a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
         1) AHI Supply Co.: www.ahi-supply.com.
         2) PROSOCO, Inc.: www.prosoco.com.
      b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
         1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

F. Non-Acidic Liquid Cleaner:
   1. Mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood:
   2. Manufacturers:
      a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
         1) AHI Supply Co.: www.ahi-supply.com.
         2) Diedrich Technologies, Inc.; a division of Sandell Construction Solutions: www.diedrichtechnologies.com.
         3) PROSOCO, Inc.: www.prosoco.com.
      b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
         1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

G. Mild acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches:
   1. Manufacturers:
      a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
         1) AHI Supply Co.: www.ahi-supply.com.
         2) Diedrich Technologies, Inc.; a division of Sandell Construction Solutions: www.diedrichtechnologies.com.
         3) PROSOCO, Inc.: www.prosoco.com.
      b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
         1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

H. Acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors:
   1. Manufacturers:
      a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
         1) AHI Supply Co.: www.ahi-supply.com.

2) American Building Restoration Products, Inc.
3) PROSOCO, Inc.: www.prosoco.com.

b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

I. One-Part Limestone Acidic Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.
1. Manufacturers:
a. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

J. Two-part chemical cleaner system consisting of potassium - or sodium hydroxide based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid:
1. Manufacturers:
a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1) AHI Supply Co.: www.ahi-supply.com.
2) Diedrich Technologies, Inc.; a division of Sandell Construction Solutions: www.diedrichtechnologies.com.
3) PROSOCO, Inc.: www.prosoco.com.
b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.12 CHEMICAL CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical cleaner manufacturer.

B. Acidic Cleaner Solution for Non-Glazed Masonry and Unpolished Stone:
1. Dilute acidic cleaner with water to produce hydrofluoric acid content of 3% or less, but not greater than that recommended in writing by chemical-cleaner manufacturer:
a. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.

C. Acidic Cleaner for Galzed Masonry Glazed Masonry and Polished Stone:
1. Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch, or otherwise damage glazed or polished surface, but not greater than that recommended in writing by chemical-cleaner manufacturer:
a. Stones: Use only on polished granite and polished dolomite marble.

2.13 MASKING MATERIALS

A. Liquid Strippable Masking Agent:
1. Liquid, film forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners:
2. Manufacturers:
a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1) American Building Restoration Products, Inc.: www.abrp.com.

2) PROSOCO, Inc.: www.prosoco.com.

b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

A. Protection of Masonry:
   1. During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress:
      a. Extend cover a minimum of 24 inches (610 mm) down both sides of walls and hold cover securely in place.
      b. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (610 mm) down face next to unconstructed wythe and hold cover in place.

B. Stain Prevention:
   1. Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry:
      a. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
      b. Protect sills, ledges, and projections from mortar droppings.
      c. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
      d. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements:
   1. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 402/602:
      a. Cold-weather cleaning: Use liquid cleaning methods only when air temperature is 40 degrees F (4.4 degrees C) and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.

3.2 COORDINATION

A. Build openings and chases for heating, plumbing, electrical ducts, pipes, and conduits into masonry walls as necessary. Install bolts, toggles, flashings, beams, anchors, hangers, nailing strips, wall plugs, and frames as necessary:
   1. Coordinate related work incorporating installation of work to prevent subsequent cutting and patching.
   2. Coordinate installation of steel reinforcement for reinforced masonry.
   3. Coordinate dampproofing, waterproofing, and air infiltration membrane activities with masonry construction.
   4. Coordinate placement of concrete in masonry beams, lintels, soffits, and pilasters.

3.3 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work:
   1. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the work.
   2. Verify foundations are within tolerances specified.
   3. Verify reinforcing dowels are properly placed.
   4. Verify substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation after correcting unsatisfactory conditions.

3.4 MORTAR AND GROUT

A. Mixing Mortar and Grout
   1. Accurately measure materials in suitably calibrated devices; shovel measurements are not acceptable.
   2. Place sand, cement, and water in mixer, in that order, and mix for at least 2 minutes. Add lime putty and continue mixing as long as necessary to secure a uniform mass, but in no case less than 10 minutes.
   3. Use mixers of at least one sack capacity; batches requiring fractional sacks will not be permitted unless cement is weighed for each batch.

B. Grouting Procedures
   1. As specified in Related Section(s).

C. Retempering
   1. When necessary to retemper mortar, add water and remix; retempering by dashing water over mortar will not be permitted.
   2. Any mortar that is unused within 30 minutes after initial mixing and any mortar that has begun to set shall not be used.

D. Defective Mortar or Grout
   1. Should the strength of mortar or grout fall below that specified, remainder of Work shall be adjusted to reach required strength. Work in place representing inferior grout and mortar and indicating a strength less than the minimum specified shall be tested by taking and testing core samples. Number and location of cores shall be determined by Structural Engineer.
   2. Should compression tests of cores fail to meet required strength, masonry shall be deemed to be defective and shall be removed and replaced at no cost to the Owner.
   3. Costs relative to taking and testing of core samples shall be paid by the Owner and will be deducted from Contract amount. Cost of patching core holes shall be borne by the Contractor.

3.5 INSTALLATION, GENERAL

A. Construct masonry veneer in compliance with TMS 402/602.

B. Thickness: Build single wythe walls to actual widths of masonry units, using units of widths indicated.

C. Build chases and recesses to accommodate items specified in this and other Sections.

D. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

E. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures:
   1. Mix units from several pallets or cubes as they are placed.

G. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

H. All masonry shall be laid true, level, plumb, and as indicated on Drawings.

3.6 TOLERANCES, GENERAL

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (13 mm) or minus 1/4 inch (6 mm).
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (13 mm).
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (13 mm) total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (13 mm) maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 3.1 m), or 1/2 inch (13 mm) maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6.1 m), or 1/2 inch (13 mm) maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 3.1 m), or 1/2 inch (13 mm) maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6.1 m), or 1/2 inch (13 mm) maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (13 mm) maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.6 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch (13 mm); do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
   2. For exposed bed joints, do not vary from bed joint thickness of adjacent courses by more than 1/8 inch (3 mm).
   3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (10 mm) or minus 1/4 inch (6 mm).
   4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
   5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.6 mm) from one masonry unit to the next.

3.7 LAYING MASONRY, GENERAL REQUIREMENTS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond. Do not use units with less than nominal 4 inches (102 mm) horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

G. Fill all cores in hollow CMU with grout.

3.8 MORTAR BEDDING AND JOINTING

A. Lay masonry units as indicated in appropriate Section.

B. Set stone and cast stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
   1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
   2. Allow cleaned surfaces to dry before setting.
   3. Wet joint surfaces thoroughly before applying mortar.
   4. Rake out mortar joints for pointing with sealant.

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, cavity wall insulation, or air barriers unless otherwise indicated.

3.9 MASONRY JOINT REINFORCEMENT

A. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
   1. Space reinforcement not more than 5/8 inch (16 mm) o.c.
   2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond opening in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T shaped units.

D. Provide continuity at corners by using prefabricated L shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.10 ANCHORED VENEERS

A. Ties and Anchors: Extend ties and anchors a minimum 1-1/2 inches (38 mm) into veneer but with at least a 5/8 inch (16 mm) cover on outside face.

B. Provide not less than 1/2 inch (13 mm) of airspace between back of masonry veneer and face of masonry:

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.11 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
   1. Provide an open space not less than 2 inches (51 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
   2. Anchor masonry with anchors embedded in masonry joints and attached to structure.Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (914 mm) o.c. horizontally.
   3. Anchor masonry with anchors embedded in masonry joints and attached to structure.

B. Anchor veneers to concrete masonry backup with masonry anchor ties and veneer ties as indicated on the Drawings. Comply with the following requirements:
   1. Embed anchor ties in masonry joints as indicated on Drawings.
   2. Fasten veneer ties to masonry backup through loops of anchor ties projecting from masonry surface.
   3. Space anchors ties as indicated, but not more than 12 inches (305 mm) o.c. vertically and 12 inches (305 mm) o.c. horizontally, with not less than one anchor for each square foot (10 anchors for each square meter) of wall area. Install additional anchors at openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

3.12 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete backup with seismic masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
   3. BIA Technical Notes 28B recommends 2 inches (51 mm) of air space. Wider air spaces require closer tie spacing.
   4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   5. Space anchors as indicated, but not more than 18 inches (457 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than one anchor for each 2 square feet (five anchors for each square meter) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm) 8 inches, around perimeter.
   6. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally with not less than one anchor for each 3-1/2 sq. ft. (0.3 m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm) 36 inches, around perimeter.

3.13 CONTROL AND EXPANSION JOINTS

A. Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 - Joint Sealants, but not less than 3/8 inch (10 mm):
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.14 LINTELS

A. Provide steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 24 inches (610 mm) for block size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (203 mm) at each jamb unless otherwise indicated.

3.15 FLASHING, WEEPS, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
   1. Install flashing as follows unless otherwise indicated:
      a. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
      b. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (203 mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (102 mm).
      c. At lintels and shelf angles, extend flashing a minimum of 6 inches (152 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (152 mm) at ends and turn up not less than 2 inches (51 mm) to form end dams.
      d. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant for application indicated.
      e. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
      f. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
   2. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

B. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
   1. Use specified weep/vent products to form weep holes.
   2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
   3. Space weep holes 24 inches (610 mm) o.c. unless otherwise indicated.
   4. Retain last subparagraph above if weep holes other than plastic tubing or wicking are used. Retain first subparagraph below if plastic tubing or wicking is used.
   5. Space weep holes formed from plastic tubing or wicking material 16 inches (406 mm) o.c.
   6. Trim wicking material flush with outside face of wall after mortar has set.

D. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (51 mm), to maintain drainage.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" article.

F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents:

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: The Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections:
   1. Special inspections according to Level C in TMS 402/602:
      a. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
      b. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
      c. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5,000 sq. ft. (465 sq. m) of wall area or portion thereof.

E. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.

F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

3.17 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: During construction, minimize any mortar or grout stains on the wall. Immediately remove any staining or soiling that occurs:
   1. For precision or textured units, except as noted below, clean masonry by dry brushing before tooling joints.
   2. For burnished, glazed, or pre-finished concrete masonry units, immediately remove any green mortar smears or soiling with a damp sponge.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. After mortar is thoroughly set and cured, clean exposed masonry:
      a. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
      b. Test cleaning methods on sample wall panel; leave 1/2 of panel uncleaned for comparison purposes. Obtain the Architect's approval of sample cleaning before proceeding with cleaning of masonry.
      c. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
      d. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
      e. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."

f. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
g. Do not use acids on concrete masonry units.
h. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

E. At completion of masonry work, remove all scaffolding and equipment used during construction, and remove all debris, refuse, and surplus masonry material from the site:
1. Comply with Construction Waste Management plan.

3.18 MASONRY WASTE DISPOSAL

A. Refer to Section 01 74 19 - Construction Waste Management and Disposal.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off the Owner's property.

3.19 WATER REPELLENT APPLICATION

A. Cleaning shall be complete and accepted by the Architect, and wall surfaces shall be thoroughly dry prior to application.

B. Apply water repellent in strict accordance with water repellent manufacturer's instructions.

END OF SECTION 04 05 00

SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Concrete block.
   2. Clay facing brick.
   3. Common brick.
   4. Hollow brick.
   5. Mortar and grout.
   6. Reinforcement and anchorage.
   7. Flashings.

B. Related Sections:
   1. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
   2. Section 03 30 00 - Cast-in-Place Concrete: Installation of dovetail slots for masonry anchors.
   3. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
   4. Section 07 62 00 - Roof-Related Sheet Metal: Through-wall masonry flashings.
   5. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.

C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.

D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.

E. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale); 2023.

F. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2023.

G. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.

H. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2023.

I. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

J. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

K. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

L. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.

M. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

N. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

O. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale); 2022.

P. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

Q. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

R. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

S. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

T. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

U. UL (FRD) - Fire Resistance Directory; Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Refer to Section 01 31 00 - Project Management and Coordination for additional requirements.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.
   1. Include calculations or selections from the manufacturer's prescriptive design tables that indicate compliance with the applicable building code and project conditions.
   2. Include the design engineer's stamp or seal on each sheet of shop drawings.

D. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.

E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

F. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

G. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

H. Designer's Qualification Statement.

I. Manufacturer's Qualification Statement.

J. Installer's Qualification Statement.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Units: Furnish additional units of each type, size, and color combination equal to 1 percent of each type provided, with a minimum of 10 units..

1.6 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
   1. Maintain one copy of each document on project site.

B. Fire Rated Assemblies: Comply with applicable code for UL (FRD) Assembly No. E119.

C. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

D. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.

E. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

B. Handle and store unit masonry in protective cartons or trays. Do not remove from protective packaging until ready for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Concrete Masonry Units:
      a. Acme Block & Brick: www.acmeblockandbrick.com.
      b. Best Block: www.bestblock.com.
      c. Boral Industries Company:
      d. Concrete Products Group (The): www.concreteproductsgroup.com.
      e. Omni Block, Inc.: www.omniblock.com.
      f. Revels Block & Brick Company:
      g. Texas Building Products, Inc.:
   2. Brick Mansonry Units:
      a. ACME Block & Brick: www.acmeblockandbrick.com.
      b. Belden Brick: www.beldenbrick.com.
      c. Endicott Clay Products Co: www.endicott.com.
      d. General Shale, a subsidiary of Wienerberger AG: www.generalshale.com.
      e. Interstate Brick: https://interstatebrick.com.
      f. Meridian Brick LLC: www.meridianbrick.com.
   3. Reinforcement and Anchorage:
      a. Blok-Lok Limited: www.blok-lok.com.
      b. Hohmann & Barnard, Inc: www.h-b.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum: AWS D1.2/D1.2M.
      b. Sheet Steel: AWS D1.3/D1.3M.
      c. Stainless Steel: AWS D1.6/D1.6M.
      d. Steel: AWS D1.1/D1.1M.

2.3 CONCRETE MASONRY UNITS

A. Burnished Concrete Block: Comply with referenced standards and as follows:
   1. Basis of Design: Best Block.
   2. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth as indicated on Drawings..
   3. Special Shapes: Provide non-standard blocks configured for corners, lintels. headers, control joint edges, and other conditions indicated on Drawings.
      a. Provide bullnose units for outside corners.
   4. Load-Bearing Units: ASTM C90, normal weight.
      a. Both hollow and solid block, as indicated.
      b. Exposed Faces: Manufacturer's full range of colors and textures where indicated.

5. Non-Loadbearing Units: ASTM C129.
    a. Hollow block, as indicated.
    b. Normal weight.

B. Insulated Concrete Units:
1. Standard Units with Factory-Installed Insulation Inserts: ASTM C90, normal weight.
    a. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth of 8 inches (200 mm).
    b. Insulation Type: Manufacturer's standard expanded polystyrene (XPS).
    c. Exposed Faces: Color and texture to match Architect's sample.
    d. Basis of Design:
        1) _____ manufactured by _____.

2.4 BRICK UNITS

A. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
1. Basis of Design Product:
    a. BK-1:
        1) Manufacturer: Kansas Brick and Tile.
        2) Color:Galena Park Blend.
        3) Finish: _____.
        4) Size: _____.
    b. BK-2:
        1) Manufacturer: Kansas Brick and Tile.
        2) Color:500 Manganese.
        3) Finish: As selected by the Architect.
        4) Size: Modular.
2. Special Shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

B. Building (Common) Brick: ASTM C62, Grade SW; solid units.
1. Nominal size: As indicated on Drawings.

C. Hollow Facing and Building Brick: ASTM C652, Grade SW; Type HBS; Class H40V.
1. Nominal size: As indicated on drawings.

2.5 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M, Type N.
1. Colored Mortar: Premixed cement as required to match Architect's color sample.

B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
1. Not more than 0.60 percent alkali.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Aggregate: ASTM C144.

E. Grout Aggregate: ASTM C404.

F. Water: Clean and potable.

2.6 REINFORCEMENT AND ANCHORAGE

A. Basis of Design Products:
1. Products manufactured by Blok-Lok Limited.
2. X-Seal Anchor manufactured by Hohmann & Barnard, Inc.
3. Products manufactrued by WIRE-BOND.

B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

C. Single Wythe Joint Reinforcement: ASTM A951/A951M.

1. Type: Truss or ladder.
2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.

D. Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
1. Type: Truss.
2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.

E. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
1. Type: Truss, with adjustable ties or tabs spaced at 16 in (406 mm) on center.
2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
3. Size: 0.1875 inch (4.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods and adjustable components of 0.1875 inch (4.8 mm)wire, width of components as required to provide not less than 5/8 inch (16 mm) of mortar coverage from each masonry face.
4. Vertical Adjustment: Not more than 1 1/4 inches (32 mm).
5. Insulation Clips: Provide clips at tabs or ties designed to secure insulation against outer face of inner wythe of masonry.

F. Strap Anchors: Bent steel shapes, 1-1/2 inch (38 mm) width, 0.105 inch (2.7 mm) thick, 24 inch (610 mm) length, with 1-1/2 inch (38 mm) long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.

G. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face.

2.7 FLASHINGS

A. Metal Flashing Materials: Refer to Section 07 62 00 - Roof Related Sheet Metal.

2.8 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

3.4 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
1. Bond: As indicated on Drawings.
2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
3. Mortar Joints: Concave.

D. Brick Units:
   1. Bond: As indicated on Drawings.
   2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).
   3. Mortar Joints: Concave.

3.5 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar and mortar smears as work progresses.

E. Interlock intersections and external corners, except for units laid in stack bond.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.6 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch (16 mm) mortar cover on each side.

E. Lap joint reinforcement ends minimum 6 inches (150 mm).

F. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches (400 mm) on center.

G. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches (900 mm) horizontally and 24 inches (600 mm) vertically.

H. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches (38 mm) with at least 5/8 inch (16 mm) mortar cover to the outside face of the anchor.

3.7 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions and at least 6 inches (152 mm), minimum, into adjacent masonry or turn up flashing ends at least 1 inch (25.4 mm), minimum, to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Terminate flashing up 8 inches (203 mm) minimum on vertical surface of backing:

1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
2. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's directions.
3. Terminate vertical leg of flashing into bed joint in masonry or reglet in concrete.
4. Anchor vertical leg of flashing into backing with a termination bar and sealant.
5. Apply cap bead of sealant on top edge of self-adhered flashing.

C. Support flexible flashings across gaps and openings.

3.8 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.

C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.

D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).

E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).

F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

3.9 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.10 PARGING

A. Dampen masonry walls prior to parging.

B. Scarify each parging coat to ensure full bond to subsequent coat.

C. Parge masonry walls in two uniform coats of mortar to a total thickness of 3/4 inch (19 mm).

D. Steel trowel surface smooth and flat with a maximum surface variation of 1/8 inch per foot (1 mm/m).

E. Strike top edge of parging at 45 degrees.

3.11 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.12 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 04 20 00

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SECTION 04 73 17 - CALCIUM SILICATE MANUFACTURED STONE MASONRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Calcium Silicate Masonry Units (CSMU).
   2. Accessories as required for a complete installation.

B. Related Sections:

1.3 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

B. ASTM C73 - Standard Specification for Calcium Silicate Brick (Sand-Lime Brick); 2023.

C. ASTM C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle); 2022.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data:
   1. Submit manufacturers data sheets for the extruded aluminum channels, Calcium Silicate Masonry Units, weep vents, and sealant materials.

C. Shop Drawings:
   1. Indicate unit types, patterns, coursing, support structure, and accessories as required.

D. Samples:
   1. Two 4 inche by 4 inches in size, indicating color and finish.
   2. Specimen warranty.

E. Certificates:
   1. Certify that products of this section meet or exceed specified requirements.

F. Delegated Design Submittals:
   1. Drawings and calculations sealed by Designer.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
   2. Fabricator Qualifications: Company specializing in fabricating products specified in this section, with at least three years of documented experience.
   3. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
   4. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

B. Installer: Company or person specializing in commercial masonry, stone work or other reputable company with demonstrable experience with 3 years documented experience].

C. Manufacturer's representative to be on site once every 2 weeks to review site conditions, installation and quality of work. Arriscraft representative will report in writing any findings not meeting the construction documents to the General Contractor.

1.6 MOCKUPS

A. Construct typical mockup as indicated on Drawings to illustrate units, coursing, sealant joints, and extruded aluminum support channels.

B. Mockup may remain part of the finished Work.

C. The approved jobsite mockup panel shall be used to determine the level of workmanship expected on the buildings veneer installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 01 60 00 - Product Requirements.

B. Deliver Calcium Silicate Masonry Units to the site in approved protective film. Prevent damage to units.

C. Lift skids with proper and sufficiently long slings or forks with protection to prevent damage to units. Protect edges and corners.

D. Store units in a manner designed to prevent damage and staining of units.

E. Stack units on timbers or platforms at least 3 inches (76 mm) above grade.

F. Place polyethylene or other plastic film between wood and other finished surfaces of units when stored for extended periods of time.

G. Cover stored units with protective enclosure if exposed to weather.

H. Do not use salt or calcium-chloride to remove ice from unit surfaces.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Arriscraft, a General Shale group, a subsidiary of Wienerberger AG: www.arriscraft.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 PERFORMANCE / DESIGN CRITERIA

A. Engineering for the exterior building wall support system is the structural engineer of record's responsibility.

B. Calcium Silicate units shall be anchored at spacings to meet all Building Codes governing this project, including wind load requirements and wind pressures design loads as required

2.3 MATERIALS

A. Thin Calcium Silicate Units:
   1. Basis of Design:
      a. ARRIS▪clip Renaissance manufactured by Arriscraft.
   2. Comply with ASTM C73, Grade SW; solid units having been pressure formed and autoclaved.
   3. Bed Depth: 3-5/8 inch.
   4. Size: As indicated on Drawings.
   5. Finish: As indicated on Drawings.
   6. Special Shapes: As indicated on Drawings or as required.
   7. Schedule:
      a. CSM-1:
         1) Size: 3-5/8 inch D by 11-5/8 inch H bt 23-5/8 inch L.
         2) Color: Oak Ridge .

3) Pattern: Running Bond.
4) Texture: Smooth.

B. Anchors:
1. Basis of Design:
a. Gridworx Extruded Aluminum Channels manufactured by Precision Wall Systems, Inc.
2. Fabricate anchors from extruded aluminum alloy and temper as required to support loads imposed without exceeding allowable design stresses, but not less than strength and durability properties of Alloy 6005-T5. Channels shall be provided in 12 foot (3.6 m) lengths. “L Brackets” shal be 23-5/8 inch (600 mm) in length and set in the full length of each clip unit. Aluminum channels of the Pressure Equalized Rainscreen system shall be anodized with a clear coating and the “L” brackets shall be anodized with a black coating, and both annodized coatings shall meet AAMA 611.

C. Vertical Water blockers will be made from PC/PBT Alloy, UV Stabilized and Black in color with the follwing properties:
1. Tensile Strength: 7300 psi, to D638.
2. Tensile Elongation: 90 percent, to D638.
3. Flexural Strength: 11500 psi, to D790.
4. Flexural Modulus: 300,000 psi, to D7 Tensile Strength: 7300 psi, to D638.
5. Izod Impact Strength, Notched 23°C: 14.0
6. Izod Impact Strength, Notched, -20°C: 4.0

D. Threaded Fasteners:
1. Elco Dril-Flex or HILTI Kwik-Flex fasteners, #12 X 2” self drilling structural fasteners – SAE J 429 / Grade 5 with a Stalgard Coating. Installation to be on studs with a minimum of 18 gauge set on 16” centers.
2. Provide 3/16” Tap-con or other comperable concrete screw at concrete or CMU block substrates.
3. Provide #12 Hex-head stainless steel screws at wood frame studs.

2.4 ACCESSORIES

A. Flexible Flashing: Stainless steel.

B. Weep Vents: Galvanized steel tubes.

C. Shims: Full bearing (3 inches (76 mm) or greater vertical dimension) hi-impact resistant plastic shims.

D. Sealant for Joints: Low modulus silicone expansion joint sealant meeting ASTM C719, SWRI validation and manufacturer’s 20-year weather seal warranty. Prior to installation of the low modulus silicone joint sealant, installer should contact the sealant manufacturer for proper application and compatibility guidelines.
1. Basis of Design:
a. Dow Corning 790.

2.5 FABRICATION TOLERANCES

A. Fabricate Thin Calcium Silicate Units to the following tolerances:
1. Unit Length: Plus or minus 1/16 inch (1.6 mm).
2. Unit Height: Plus or minus 1/16 inch (1.6 mm).
3. Deviation From Square: Plus or minus 1/16 inch (1.6 mm), with measurement taken using the longest edge as the base.
4. Bed Depth: Plus or minus 1/8 inch (3 mm).
5. Custom Dimensions: Plus or minus 1/8 inch (3 mm).
6. Unit Face Deviations: Plus or minus 3/8 inch (10 mm).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that site conditions are ready to receive work.

B. Beginning of installation means acceptance of site conditions.

3.2 INSTALLATION

A. Install per manufacturer's instructions.

3.3 CUTTING OF THIN CALCIUM SILICATE UNITS

A. Cut thin Calcium Silicate units with a wet-saw.

B. Pre-soak units using clean water prior to cutting.

C. Clean cut units using a stiff fibre brush and clean water. Allow units to surface dry prior to placement.

D. All Calcium Silicate units shall be cut accurately to shape and dimensions and full to the square, with jointing as shown on drawings

E. Any miscellaneous cutting and drilling of Thin Calcium Silicate Units necessary to accommodate other trades will be the responsibility of the installer.

F. Incidental cutting such as for window frame clips, etc., which is normally not considered to be the responsibility of the Thin Calcium Silicate Unit supplier, will be provided only by arrangement by the contractor with the Thin Calcium Silicate Units supplier.

3.4 COURSING

A. Place masonry to lines and levels indicated.

B. Maintain thin masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness.

C. Place thin masonry units using bond indicated on Drawings..

D. Maintain sealant joint thickness of 3/8 inch (10 mm).

3.5 TOLERANCES

A. Variation in Alignment from Unit to Adjacent Unit: 1/16 inch (1.6 mm) maximum.

B. Variation of Sealant Joint Thickness: 1/8 inch (3 mm) in 36 inches (914 mm).

3.6 FLASHING

A. Extend flashing under veneer system, turn up structural back-up under the moisture barrier and bed into mortar joint of masonry, seal to concrete, or seal into sheathing over stud framed back-upm as required.

B. Lap end joints and seal watertight.

3.7 INTERFACE WITH OTHER WORK

A. Calcium Silicate units coming in contact with structural work shall be back-checked.

B. Thin Calcium Silicate Units resting on structural work shall have beds shaped to fit the supports as required. Maintain a minimum of 1 inch (25 mm) clear at metal studs and sheathing board between stone backs and adjacent structure. Note: Some bolted connections may require more space than this. Verify and make provision for these conditions.

3.8 CLEANING

A. Clean the Calcium Silicate units as work progresses.

B. Post-Construction: Clean a 100 sq. ft. (10 sq. m) 100 sq. ft. area of wall ir mock-up panel, as directed by the Architect, per requirements below and leave for one week. If no harmful effects appear. clean Calcium Silicate unit veneer as follows:

1. Protect windows, sills, doors, trim and other work from damage.

2. Remove large particles with stiff fiber brushes ir wood paddles without damaging surface. Saturate thin units with clean water and flush off loose dust and dirt.
3. Scrub with solution of 1 tsp. trisodium phosphate and 1 tsp. household detergent dissolved in 4 cups of clean water using stiff fibre brushes, then clean off immediately with clean water using a hose.
4. Repeat cleaning process as often as necessary to remove any stains.

C. Acids are not permitted without written approval. Protect masonry from rundown or splash when using acid on adjacent materials.

D. Use alternative cleaning solutions and methods for difficult to clean units only after consultation with thin unit manufacturer.

3.9 PROTECTION

A. Protect thin units from damage resulting from subsequent construction operations.

B. Use protection materials and methods which will not stain or damage Calcium Silicate Units.

C. During construction, tops of walls shall be carefully covered at night, and especially during any precipitation or other inclement weather.

D. Remove protection materials upon Substantial Performance of the Work, or when risk of damage is no longer present.

E. At all times, walls shall be adequately protected from droppings.

END OF SECTION 04 73 17

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SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Structural steel.
2. Prefabricated building columns.

B. Related Sections:
1. Section 01 45 23 "Testing and Inspection Services".
2. Section 05 12 13 "Architecturally Exposed Structural Steel Framing".
3. Section 05 31 00 "Steel Decking".
4. Section 13 34 19 "Metal Building Systems".

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:
1. Shapes included in ASTM A 6 with flanges thicker than 1 1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 REFERENCES

A. Comply with applicable provisions of the following specifications and documents: The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
1. AISC "Code of Standard Practice for Steel Buildings and Bridges”.
2. AISC "Specification for Structural Steel Buildings," including the "Commentary" and the Supplements thereto, as issued.
3. AISC "Specification for Architecturally Exposed Structural Steel”.
4. AISC's "Seismic Provisions for Structural Steel Buildings”.
5. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use”.

6. AWS D1.1 Structural Welding Code.
7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
8. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
9. SSPC (Steel Structures Painting Council), Painting Manuals, Volumes 1 and 2.
10. UL Fire Resistance Directory.

B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.5 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.

B. Moment Connections: Type FR, fully restrained.

C. Construction: System as indicated on Drawings.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.
8. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. At full penetration welds, Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

A. Submit the following informational submittals:
1. Qualification Data: For qualified installer, fabricator, and testing agency.
2. Welding certificates.
3. Mill test reports for structural steel, including chemical and physical properties.

4. Product Test Reports: For the following:
   a. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   b. Direct-tension indicators.
   c. Tension-control, high-strength bolt-nut-washer assemblies.
   d. Shear stud connectors.
   e. Shop primers.
5. Source quality-control reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 341 and AISC 341s1.
   3. AISC 360.
   4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

F. Preinstallation Conference: Conduct conference at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
   1. W-Shapes: 60 percent.
   2. Channels, Angles, M, S-Shapes: 60 percent.
   3. Plate and Bar: 25 percent.
   4. Cold-Formed Hollow Structural Sections: 25 percent.
   5. Steel Pipe: 25 percent.
   6. All Other Steel Materials: 25 percent.

B. W-Shapes: Refer Structural General Notes.

C. Channels, Angles, M, S-Shapes: Refer Structural General Notes.

D. Plate and Bar: Refer Structural General Notes.

E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588, Grade 50.

F. Cold-Formed Hollow Structural Sections: Refer Structural General Notes.

G. Steel Pipe: Refer Structural General Notes.
   1. Weight Class: See Plans.
   2. Finish: Black except where indicated to be galvanized.

H. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts.
   1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers (All bolts located in Crawl Space): ASTM A 325, Type 1, heavy-hex steel structural bolts.
   1. Finish: Hot-dip or mechanically deposited zinc coating.
   2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain or Mechanically deposited zinc coating, where required.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

E. Unheaded Anchor Rods: ASTM F 1554, See Anchor Bolt Schedule on Drawings for Grade.
1. Configuration: Straight.
2. Nuts: ASTM A 563 heavy-hex carbon steel.
3. Plate Washers: ASTM A 36 carbon steel.
4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish:
   a. General Condition – Plain
   b. Crawl Space - Hot-dip zinc coating, ASTM A 153, Class C.

F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

I. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Amscot Structural Products Corp.
   b. Fluorocarbon Company Limited.
   c. R.J. Watson Bridge & Structural Engineered Systems.
   d. Seismic Energy Products, L.P.
2. Mating Surfaces: PTFE and PTFE or mirror-finished stainless steel.
3. Coefficient of Friction: Not more than 0.05.
4. Design Load: Not less than 5,000 psi .
5. Total Movement Capability: 2 inches.

2.3 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer (General): Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Primer (Crawl Space Steel): Tnemec Perimeprime Series 394.

D. Galvanizing Repair Paint: SSPC-Paint 20.

2.4 GROUT

A. Refer Section 03 30 00.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in final approved Shop Drawings.
   1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
   2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other effects.
   3. Camber structural steel members where indicated. The camber specified is the camber that is measured in the field with the beam on its side so that the beam weight has no effect. During shipment and handling, cambered members shall be supported in a way that will not result in loss of camber.
   4. Camber tolerance
      a. Beams 50 feet and less; plus or minus 1/2 inch.
      b. Beams greater than 50 feet; plus or minus 1/2 inch, except tolerance can be increased 1/8 inch for each 10 feet or fraction thereof in excess of 50 feet.
      c. Contact engineer for members outside specified camber tolerance. Provide engineer with a list of beam locations and actual measured camber amounts. Submit an engineered shoring plan, if requested, that will allow the beam to deflect to the horizontal position after concrete placement without overloading the framing below.
   5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
   6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

H. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on approved shop drawings.

1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes by burning.

I. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Base plates hole sizes for anchor bolts may be oversized to facilitate erection:
1. Bolts 3/4 inch to 7/8 inch diameter: 1/2 inch oversize.
2. Bolts 1 inch to 1 1/2 inch diameter: 3/4 inch oversize.
3. Bolts over 1 3/4 inch diameter: 1 inch oversize.

J. Base Plate Washers: Sizes shall be as follows:
1. 3/4 inch diameter Bolts: 2 inch diameter x 1/4 inch thick
2. 7/8 inch diameter Bolts: 2 1/2 inch diameter x 5/16 inch thick
3. 1 inch diameter Bolts: 3 inch diameter x 3/8 inch thick
4. 1 1/4 inch diameter Bolts: 3 inch diameter x 1/2 inch thick
5. 1 1/2 inch diameter Bolts: 3 1/2 inch diameter x 1/2 inch thick
6. 1 3/4 inch diameter Bolts: 4 inch diameter x 5/8 inch thick
7. 2 inch diameter Bolts: 5 inch diameter x 3/4 inch thick

K. Architecturally Exposed Structural Steel (AESS): Fabricate with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
2. Comply with fabrication requirements, including tolerance limits, of AISC's "Specification for Architecturally Exposed Structural Steel" for architecturally exposed structural steel.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, Pretensioned, or Slip critical as required or indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8, where required, for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing) excluding crawl space steel. Crawl space steel shall be primed regardless of whether it is to receive fireproofing.
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

D. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

E. Crawl space steel to be primed to a DFT between 2.5 and 3.5 mils.

F. Painting: Prepare steel and apply a one-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

G. GALVANIZING

H. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
   1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels and shelf angles attached to structural steel frame and located in exterior walls.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Refer Section 01 45 23.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations, to elevations indicated, and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow it to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened, Pretensioned, or Slip critical as indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: See Section 01 45 23.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 00

SECTION 05 21 00 – STEEL OPEN WEB JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. LH- and DLH-series long-span steel joists.
5. CJ-series composite steel joists.
6. Joist girders.
7. Joist accessories.
8. Extended ends.
9. Ceiling extensions.
10. Bearing plates.
11. Bridging.
12. Side wall anchors.

B. Related Requirements:
1. Section 03 30 00 "Cast-in-Place Concrete".
2. Section 01 45 23 “Testing and Inspection Services”
3. Section 04 20 00 "Unit Masonry".
4. Section 05 12 00 "Structural Steel Framing".
5. Section 05 31 13 “Steel Floor Decking”.
6. Section 05 31 23 “Steel Roof Decking”.

1.3 REFERENCES

A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.

B. AWS D1.1 Structural Welding Code

C. SJI “Standard Specification Load Tables and Weight Tables for Steel Joists and Joist Girders”.

D. SDI “Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution”.

E. SSPC Steel Structures Painting Council Painting Manual.

F. UL Fire Resistance Directory.

G. ICBO Product Evaluation Reports.

H. FM Roof Assembly Classifications.

I. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support non-uniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.
Review LEED requirements with Project Architect and edit as needed. References to LEED credits below MAY NOT be current.

B. Shop Drawings:
1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.
4. Shop drawings containing special joists shall be submitted with a design load summary for each special joist design. Load summary will be reviewed and returned with the joist submittal. Shop drawings containing special joists submitted without the specified load summary will be returned unchecked as an incomplete submittal. Shop drawings containing special joists shall be signed and sealed by the qualified professional engineer responsible for the design of the joists.

1.6 INFORMATIONAL SUBMITTALS

A. Submit the following informational submittals:
1. Qualification Data: For manufacturer.
2. Welding certificates.
3. Manufacturer certificates.
4. Mill Certificates: For each type of bolt.
5. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

B. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

C. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.9 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and or masonry construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

B. Use ASD; data are given at service-load level.

C. Design special joists to withstand design loads with live-load deflections no greater than the following:
1. Floor Joists: Vertical deflection of 1/360 of the span.
2. Roof Joists: Vertical deflection of 1/360 of the span.

D. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

2.2 MATERIALS

A. Steel: Comply with SJI's "Specifications" for chord and web members.

2.3 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Top-Chord Extensions and Extended Ends: Provide top chord extension or extended ends where shown on plans. Design for load indicated on plans.

E. Camber joists according to SJI's Specifications unless noted otherwise.

F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on plan.
1. Joist Type: Refer to Drawings.

2. End Arrangement: Refer to Drawings.
3. Top-Chord Arrangement: Refer to Drawings.

B. Provide holes in chord members for connecting and securing other construction to joists.

C. Camber long-span steel joists according to SJI's Specifications unless noted otherwise.

D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.5 JOIST GIRDERS

A. Manufacture joist girders according to "Standard Specifications for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated on plan.
1. End Arrangement: Refer to Drawings.
2. Top-Chord Arrangement: Refer to Drawings.

B. Provide holes in chord members for connecting and securing other construction to joist girders.

C. Camber joist girders according to SJI's Specifications unless noted otherwise.

D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.6 PRIMERS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.7 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint for interior exposure or Hot-dip zinc coat according to ASTM A 123/A 123M for exterior or weather exposure.

C. Furnish ceiling extensions (where indicated), either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

D. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
Finish: Plain, uncoated.

E. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Finish: Plain.

F. Welding Electrodes: Comply with AWS standards.

G. Galvanizing Repair Paint: ASTM A 780.

H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.8 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 2 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications", "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice," joist manufacturer's written recommendations, and requirements in this Section.

C. Before installation, splice joists delivered to Project site in more than one piece. Space, adjust, and align joists accurately in location before permanently fastening.

D. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

E. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

F. Field weld joists to supporting steel bearing plates and framework as indicated on Drawings. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance, and quality of welds, and methods used in correcting welding work.

G. Bolt joists to supporting steel framework using high-strength structural bolts as indicated on Drawings. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

H. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: See Section 01 45 23.

3.4 REPAIR AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

C. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.

1. Apply a compatible primer of same type as primer used on adjacent surfaces.

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 21 00

SECTION 05 31 13 - STEEL FLOOR DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Composite floor deck.
2. Electrified cellular floor deck.
3. Noncomposite form deck.
4. Noncomposite vented form deck.

B. Related Requirements:
1. Section 01 45 23 “Testing and Inspection Services”.
2. Section 03 30 00 "Cast-in-Place Concrete".
3. Section 05 12 00 "Structural Steel Framing".
4. Section 05 21 00 “Steel Joist Framing”

1.3 REFERENCES

A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
1. AWS D1.1 - Structural Welding Code
2. AWS D1.3 – Structural Welding Code – Sheet Steel
3. SDI – Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution.
4. SSPC – Painting Manual
5. UL – Fire Resistance Directory
6. ICBO – Product Evaluation Reports

1.4 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:
1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Submit the following informational submittals:
1. Welding certificates.
2. Product Certificates: For each type of steel deck.
3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
4. Power-actuated mechanical fasteners.
5. Evaluation Reports: For steel deck.
6. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Refer Section 01 45 23.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Verco Manufacturing Co.
13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel

Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: As indicated in Structural General Notes.
2. Profile Depth: As indicated on plan.
3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
4. Span Condition: Triple span or more.

2.3 ELECTRIFIED CELLULAR FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. CMC Joist & Deck.
2. Consolidated Systems, Inc.; Metal Dek Group.
3. Cordeck.
4. HH Robertson Floor Systems; a CENTRIA company.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.; Vulcraft Group.
8. Verco Manufacturing Co.
9. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

C. Source Limitations for Electrified Cellular Floor Deck: Obtain cellular floor-deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from single manufacturer.

D. Electrified Cellular Floor Deck: Fabricate steel-sheet cellular floor-deck panels, consisting of a ribbed top section welded to a lower flat-bottom sheet with interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck" in SDI Publication No. 31. Fabricate deck to the minimum section properties, width of panel, number and area of cells per panel indicated, and the following:

1. Cellular Deck Type: Composite.
2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G60 zinc coating.
3. Profile Depth: As indicated on plan.
4. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
5. Span Condition: Triple span or more.
6. Factory punch holes, of size and arrangement indicated, into each deck cell at preset inserts and header duct locations.

2.4 NONCOMPOSITE FORM DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Marlyn Steel Decks, Inc.
8. New Millennium Building Systems, LLC.

9. Nucor Corp.; Vulcraft Group.
10. Roof Deck, Inc.
11. Valley Joist; Subsidiary of EBSCO Industries, Inc.
12. Verco Manufacturing Co.
13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Noncomposite Form Deck: Fabricate ribbed-steel sheet non-composite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 80 minimum, with top and underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
   a. Color: Manufacturer's standard Gray.
2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 80, G90 zinc coating.
3. Profile Depth: As indicated on Plan.
4. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
5. Span Condition: Triple span or more.
6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.5 NONCOMPOSITE VENTED FORM DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.; Vulcraft Group.
8. Roof Deck, Inc.
9. Verco Manufacturing Co.
10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Noncomposite Vented Form Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 80, G60 zinc coating.
2. Profile Depth: As indicated on Plan.
3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
4. Span Condition: Triple span or more.
5. Side Laps: Overlapped or interlocking seam at Contractor's option.
6. Vent Slot Area: Manufacturer's standard vent slots providing 1.5 percent open area.

2.6 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated on Drawings.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

L. Galvanizing Repair Paint: ASTM A 780.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
   1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
   1. Weld Diameter: 3/4 inch, nominal.
   2. Weld Spacing: Space and locate welds as indicated on Drawings.
   3. Weld Washers: Install weld washers at each weld location where deck is 22 gage or less.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
   1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
   2. Mechanically clinch or button punch only with concrete filled decks.
   3. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
   1. End Joints: Butted.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Revise "Floor-Deck Closures" Paragraph below to suit Project. Sealing cellular deck openings, butt joints, and junctions with trench headers with tape is not included in this Section. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. Electrified Cellular Floor Deck: Install cellular floor system with deck assembled from units indicated.
   1. Coordinate layout and installation of trench headers, preset inserts, duct fittings, and other components specified in Section 260539 "Underfloor Raceways for Electrical Systems" with installation of electrified cellular metal floor deck.

G. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

3.4 COMPOSITE FLOOR DECK INSTALLATION

A. The composite steel deck shall be connected to the supporting steel beams by welding the shear/headed stud connectors through the deck as indicated in the drawings. Contractor to verify the attachment of the deck to the supporting member after the headed stud is welded.

Improper amperage may cause burn through around the stud and the deck may not be adequately attached to the supporting deck.

B. Where shear/headed stud connectors are not specified, the metal deck shall be attached to the supporting steel with 3/4-inch diameter puddle welds at a maximum spacing of 12 inches.

C. Where the specified shear/headed stud connector spacing exceeds 12 inches, provide 3/4-inch diameter puddle welds between shear/headed stud connectors to maintain a maximum deck connection of 12 inches.

D. Where deck units abut side to side or end to end over a supporting member provide 3/4-inch diameter puddle welds on each deck unit at a maximum spacing of 12 inches.

E. Shear/Headed Stud Connectors: Field weld shear/headed stud connectors through deck to supporting frame according to AWS D1.1 and manufacturer's written instructions. Located connectors as indicated in the drawings. Remove and discard arc shields after welding shear/headed stud connectors.

3.5 DECK AND FLOOR DEFLECTION

A. The metal deck is designed to deflect up to 3/4-inch.

B. Uncambered steel beams are designed to be within code required deflection limits (Span/240). Cambered steel beams are designed to have a final deflected shape of less than 1/2-inch. Due to field tolerances and camber tolerances, these design limits may be slightly exceeded.

C. The contractor shall account for any additional concrete required due to these deflected shape tolerances.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Refer Section 01 45 23.

B. Remove and replace work that does not comply with specified requirements.

C. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.7 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 31 23 - STEEL ROOF DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Roof deck.
   2. Acoustical roof deck.
   3. Noncomposite vented roof deck.

B. Related Requirements:
   1. Section 01 45 23 “Testing and Inspection Services”
   2. Section 05 12 00 "Structural Steel Framing".

1.3 REFERENCES

A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
   1. AWS D1.1 – Structural Welding Code
   2. AWS D1.3 – Structural Welding Code – Sheet Steel
   3. SDI – Design Manual
   4. SSPC – Painting Manual
   5. UL – Fire Resistance Directory
   6. ICBO – Product Evaluation Reports
   7. FM – Roof Assembly Classifications

B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.
   2. Acoustical roof deck.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Refer Section 01 45 23.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASC Profiles, Inc.; a Blue Scope Steel company.
   2. Canam United States; Canam Group Inc.
   3. CMC Joist & Deck.
   4. Consolidated Systems, Inc.; Metal Dek Group.
   5. Cordeck.
   6. DACS, Inc.
   7. Epic Metals Corporation.

8. 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, G60 zinc coating.
3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
   a. Color: Manufacturer's standard.
4. Deck Profile: As indicated on plan.
5. Profile Depth: As indicated on plan.
6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
7. Span Condition: Triple span or more.
8. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACOUSTICAL ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
   a. Color: Manufacturer's standard.
2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
3. Deck Profile: As indicated in Structural General Notes.
4. Cellular Deck Profile: As indicated in Structural General Notes.
5. Profile Depth: As indicated in Structural General Notes.
6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.

7. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
8. Span Condition: Triple span or more.
9. Side Laps: Overlapped or interlocking seam at Contractor's option.
10. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.
11. Sound-Absorbing Insulation: Manufacturer's standard pre-molded roll or strip of glass or mineral fiber.
    a. Factory install sound-absorbing insulation into cells of cellular deck.

2.4 NONCOMPOSITE VENTED ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.; Vulcraft Group.
8. Roof Deck, Inc.
9. Verco Manufacturing Co.
10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Noncomposite Vented Roof Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
2. Profile Depth: As indicated in Structural General Notes.
3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
4. Span Condition: Triple span or more.
5. Side Laps: Overlapped or interlocking seam at Contractor's option.
6. Vent Slot Area: Manufacturer's standard vent slots providing 1-1/2.

2.5 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

K. Galvanizing Repair Paint: ASTM A 780.

L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.
   1. Fasteners shall provide diaphragm shear and uplift resistance equal to or greater than welding indicated herein and on Drawings.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
   1. Weld Diameter: As indicated on Structural Plans.
   2. Weld Spacing: As indicated on Structural Plans.
   3. Weld Washers: Install weld washers at each weld location if deck gauge is lighter than 22 gauge.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals shown on Structural Plans:
   1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
   2. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
   1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.
   1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: See Section 01 45 23.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD FORMED METAL FRAMING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section includes requirements including but not limited to:
   1. Load bearing wall framing.
   2. Non-load bearing wall framing.
   3. Floor joist framing.
   4. Roof rafter framing.
   5. Ceiling joist framing.
   6. Soffit framing.
   7. Accessories necessary for a complete installation.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications.
   2. Section 09 90 00 - Painting and Coating.

1.3 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).

B. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

C. AISI S200 - North American Standard for Cold-Formed Steel Framing - General Provisions; 2012.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

F. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

G. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.

H. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

I. ASTM C1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections; 2018.

J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

K. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

L. ASTM E1190 - 2021 Edition, November 15, 2021 Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members; 2021 Edition, November 15, 2021.

M. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

N. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

O. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

P. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

Q. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: The Contractor shall engage a qualified professional engineer, licensed in the State in which the Project is located, to design cold formed steel framing.

B. Structural Performance: Delegated design engineer shall provide cold-formed steel framing designs capable of withstanding all code required design loads within limits and under conditions indicated on the construction documents and within this Specification:
   1. Design Loads: Designs shall be capable of withstanding the worst case loading as indicated on the structural drawings, and/or as required by the locally adopted Building Code. The design shall cover the worst case loading in all instances.
   2. Coordinate the requirements on the structural and architectural Drawings with the requirements of this Section. If a conflict exists, notations on the structural drawings take precedence.
   3. The following document governs the Work, except where more restrictive items are specified:
      a. AISI Design of Cold-Formed Steel Structural Members Wind Load:
         1) Minimum design loads for exterior and/or load bearing and/or soffit applications:
            (a) As required by code officials having jurisdiction.
            (b) Deflection: 1/600 for clear simple spans.
            (c) Deflection: 1/300 for cantilever conditions and roof parapets.
            (d) Gauge: 16 gauge minimum, unless noted otherwise.
         2) Minimum design loads for interior and/or exterior suspended furr-downs with a maximum vertical drop on either side of 5 feet or greater:
            (a) As required by Authorities Having Jurisdiction (AHJ).
            (b) Deflection: 1/600 for clear simple spans.
            (c) Deflection: 1/300 for cantilever conditions and roof parapets.
            (d) Gauge: 20 gauge minimum, unless noted otherwise.
   4. It is a common practice for studs thinner than 20 gauge to be crimped and/or ribbed to increase the strength of the overall stud cross section for various loading applications. These studs are typically noted by manufacturer as “equivalent” to a thicker gauge. These “equivalent” type studs are not allowed in a vertically suspended application with greater than 60 inch (1524 mm) of vertical wall drop, 20 gauge is the minimum thickness allowed for these applications.
   5. Welding qualifications: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."
   6. Studs, tracks, channels, and other light gauge framing members shall conform to requirements of ASTM C955.
   7. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.
   8. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 degrees F (87 degrees C).
   9. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure:
      a. Upward and downward movement of 1-1/2 inch (38 mm).
   10. Design non-load bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold Formed Steel Framing Design Standards:
   1. Wall Studs: AISI S211.
   2. Headers: AISI S212.
   3. Lateral Design: AISI S213.

1.5 SUBMITTALS

A. Product Data: Technical data for cold formed steel framing product and accessories including factory applied primers.

B. Shop Drawings:
   1. Submit layout, spacings, sizes, thickness, and types of cold formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners:
      a. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
      b. Shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas.

C. Supplementary Design Details: The general design is presumed adequate to permit compliance with the specified performance. Provide engineering calculations and shop drawings to supplement the general design. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas. Calculations and shop drawings must show design will withstand wind loading commiserate with class and rating of the Project.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Welding qualifications:
      a. Qualify procedures and personnel according to the following:
         1) AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
         2) CCFSS Technical Bulletin: “AISI Specification Provision for Screw Connections.”
   2. Comply with AISI North American Specification for the Design of Cold Formed Steel Structural Members and Standard for Cold Formed Steel Framing - General Provisions:
      a. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
   3. Fire Resistance Ratings: ASTM E119; testing by a UL. Identify products with appropriate markings of applicable testing agency. Indicate design designations from UL Fire Resistance Directory.
   4. Installer qualifications: Company specializing in the installation of cold formed metal framing components with minimum 5 years’ documented experience.
   5. Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   6. Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
   7. Mill certificates signed by steel sheet producer indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and galvanized-coating thickness.

B. Professional Engineer Qualifications:
   1. A professional engineer who is legally qualified to practice in the State in which the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold formed metal framing that are similar to those indicated in material, design, and extent:
      a. Engineering Responsibility: Preparation of shop drawings, design calculations, and structural data.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. CEMCO: www.cemcosteel.com.
   2. Clarkwestern Dietrich Building Systems, LLC: www.clarkdietrich.com.
   3. Consolidated Fabricators Corp.: www.confabbpd.com.
   4. SCAFCO Steel Stud Company, a subsidiary of the Stone Group of Companies: www.scafco.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum: AWS D1.2/D1.2M.
      b. Sheet Steel: AWS D1.3/D1.3M.
      c. Stainless Steel: AWS D1.6/D1.6M.
      d. Steel: AWS D1.1/D1.1M.

2.3 LOAD BEARING WALL FRAMING

A. Steel Studs:
   1. C-shaped steel studs, of web depths indicated, punched, with stiffened flanges:
      a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
      b. Flange Width: 1-5/8 inch (41 mm).
      c. Section Properties: As indicated on Drawings.

B. Steel Track:
   1. U-shaped steel track, of web depths indicated, unpunched, with straight flanges:
      a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
      b. Flange Width: 1-1/4 inch (32 mm).

C. Steel Box or Back to Back Headers:
   1. C-shape used to form header beams, of web depths indicated, unpunched, with stiffened flanges:
      a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
      b. Flange Width: 1-5/8 inch (41 mm).

D. Steel Single or Double L Headers:
   1. L-shapes used to form header beams, of web depths indicated:

a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
b. Top Flange Width: 1-5/8 inch (41 mm).
c. Section Properties: As indicated on Drawings.

2.4 NON-LOAD BEARING WALL FRAMING

A. Steel Studs:
1. C-shaped steel studs, of web depths indicated, punched, with stiffened flanges:
a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
b. Flange Width: 1-5/8 inch (41 mm).
c. Section Properties: As indicated on Drawings.

B. Steel Track:
1. U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
b. Flange Width: 1-1/4 inch (32 mm).

C. Vertical Deflection Clips:
1. Head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web:
2. Manufacturers:
a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1) Clarkwestern Dietrich Building Systems, LLC: www.clarkdietrich.com.
2) SCAFCO Corporation: www.scafco.com.
3) Simpson Strong-Tie Company, Inc.: www.strongtie.com.
4) Steeler, Inc.: www.steeler.com.
b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

D. Single Deflection Track:
1. Single, deep leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure:
a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
b. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.

E. Double Deflection Tracks:
1. Double, deep leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges:
a. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure:
1) Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
2) Flange width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
2. Inner Track: Of web depth indicated:

a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 2 inches (51 mm).
b. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.

F. Drift Clips: Bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 CEILING JOIST FRAMING

A. Steel Ceiling Joists:
1. C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges:
a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm).
b. Flange Width: 2 inches (51 mm).

2.6 SOFFIT FRAMING

A. Exterior Soffit Frame:
1. C-shaped steel sections, of web depths indicated, with stiffened flanges:
a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm).
b. Flange Width: 1-5/8 inch (41 mm) minimum.

2.7 FRAMING ACCESSORIES

A. Fabricate steel framing accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of appropriate thickness and configuration, unless otherwise indicated:
1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

C. Anchors, Clips, and Fasteners:
1. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot dip process according to ASTM A123/A123M.
2. Expansion anchors: Fabricated from corrosion resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
3. Power actuated anchors: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with allowable load capacities calculated, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.
4. Mechanical fasteners:
a. ASTM C1513, corrosion resistant coated, self-drilling, self-tapping, steel drill screws:
1) Head type: Low profile head beneath sheathing.
5. Welding electrodes: Comply with AWS standards.

D. Miscellaneous Materials:
1. Galvanizing Repair Paint: SSPC-Paint 20 or ASTM C780.

2. Non-Metallic, Non-Shrink Grout: Premixed, non-metallic, non-corrosive, non-staining grout containing selected silica sands, portland cement, shrinkage compensating agents, and plasticizing and water reducing agents, complying with ASTM C1107/C1107M, with fluid consistency and 30 minute working time.
3. Shims: Load bearing, high density multimonomer plastic, and non-leaching; or of cold formed steel of same grade and coating as framing members supported by shims.
4. Sealer Gaskets: Closed cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

A. Fabricate cold formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI specifications and standards, manufacturer written instructions, and specified requirements:
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted:
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to shop drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances:
   1. Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch (3 mm) in 10 feet (3 m) (1:960) and as follows:
      a. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
      b. Squareness: Fabricate each cold formed steel framing assembly to a maximum out of square tolerance of 1/8 inch (3 mm).

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

3.2 PREPARATION

A. Before sprayed fire resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire resistive materials, remove only as much as necessary to complete installation of cold formed framing without reducing thickness of fire resistive materials below required thickness to obtain fire resistance rating indicated. Protect remaining fire resistive materials from damage.

C. Install load bearing shims or grout between the underside of load bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 ERECTION

A. General:

1. Track Anchors: Install anchors maximum 4 feet (1.2 m) on center; design anchors and spacing to carry live, dead, and wind loads.
2. Track Splices: Provide channel inserts or weld track splices.
3. Erection: Install members plumb, level, and in a true plane.
4. Fastenings: Make assembly rigid and secure, with welds free of voids and burnouts.

B. Install metal framing systems in accordance with stud manufacturer's printed instructions.

C. Runner Tracks:
1. Install continuous tracks sized to match studs.
2. Align tracks accurately to layout at base and tops of studs.
3. Secure tracks as recommended by stud manufacturer, except do not exceed 24 inches (610 mm) on center for nail or power-driven fasteners, nor 16 inches (406 mm) on center for other types of attachment.
4. Provide fasteners at corners and ends of tracks.
5. Tracks shall be anchored to structural steel prior to installing sprayed on insulation.
6. Provide deflection track (DT), at top of stud walls at floor or roof above, typically. Allow for 1/2 inch (13 mm) movement of primary structure. Do not attach studs directly to deflection track.
7. Vertical deflection clips: Provide manufacturer’s standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure.

D. Secure studs to top track and bottom runner track by means of approved self-drilling screws or welding at both inside and outside flanges of 14 gauge or heavier material. Screws and welds shall be of sufficient size to insure strength of connection. All welding shall comply with American Welding Society "Specification for Welding Sheet Steel in Structures."

E. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

F. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure. Use Zee clips as specified above. Weld "Z" shaped clips to structural members as shown on drawings. Maximum 2 feet on center vertical.

G. Install supplementary framing, blocking, and bracing in the metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer's recommendations and industry standards in each case, considering the weight or loading resulting from the item supported.

H. Frame wall openings with extra studs, equal to the number of studs interrupted by wall openings, placed at each side of wall openings. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with shoes or by welding, and space jack studs same as full-height studs of the wall. Secure stud system all around to wall opening frame in the manner indicated.

I. Install bracing/bridging in accordance with manufacturer’s instructions and design conditions.

J. Touch up field welds and damaged galvanized coating, except touch up of field cut studs is not required.

K. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.

L. Install horizontal stiffeners in stud system, space (vertical distance) at no more than 54 inch (1372 mm) on center. Weld at each intersection.

3.4 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track:
   1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inch (38 mm).
   2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel stud sections as indicated on shop drawings.

C. Space joists not more than 2 inches (51 mm) from abutting walls:
   1. Joist Spacing: 16 inches (406 mm).

D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on shop drawings:
   1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on shop drawings. Fasten bridging at each joist intersection as follows:
   1. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold down angles, anchors, and fasteners, to provide a complete and stable joist framing assembly.

END OF SECTION 05 40 00

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Bollards.
      a. Door Device Mounting Post.
      b. Metal Pipe Bollards, _____.
      c. Pipe/downspout guards.
   2. Downspout boots.
   3. Metal ladders.
   4. Miscellaneous steel, including steel angle corner guards, steel edgings, and loading dock edge angles.
   5. Slotted channel framing.
   6. Accessories as necessary for complete installation.

B. Related Sections:
   1. Section 04 20 00 - Unit Masonry: CMU partitions.
   2. Section 14 20 00 - Elevators: Elevators.

1.3 REFERENCE STANDARDS

A. 2012 TAS - Texas Accessibility Standards; 2012.

B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

C. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.

D. ASTM A27/A27M - Standard Specification for Steel Castings, Carbon, for General Application; 2020.

E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

F. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

G. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

K. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2024b.

L. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.

M. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014 Edition, September 1, 2014

N. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014 Edition, September 1, 2014

O. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

P. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

Q. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

R. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.

S. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

T. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

U. ASTM A741 - Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail; 2011.

V. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

W. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015 (Reapproved 2021).

X. ASTM A793 - Standard Specification for Rolled Floor Plate, Stainless Steel; 1996.

Y. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

Z. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.

AA. ASTM B36/B36M - Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar; 2023.

BB. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.

CC. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

DD. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

EE. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.

FF. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2022.

GG. ASTM B632/B632M - Standard Specification for Aluminum-Alloy Rolled Tread Plate; 2018.

HH. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

II. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

JJ. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

KK. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

LL. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).

MM. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

NN. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.

OO. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2022.

PP. ASTM F738M - Standard Specification for Stainless Steel Metric Bolts, Screws, and Studs; 2002 Edition, April 10, 2002

QQ. ASTM F836M - Standard Specification for Style 1 Stainless Steel Metric Nuts (Metric); 2020 Edition, May 1, 2020.

RR. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

SS. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.

TT. ASTM F2329/2329M - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners; 2015.

UU. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.

VV. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

WW. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

XX. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

YY. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

ZZ. MFMA-4 - Metal Framing Standards Publication; 2004.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, licensed inthe State in which the Project is located, using performance requirements and design criteria indicated.

B. Structural Performance:
   1. Ladders: Provide ladders and landings capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
   2. Countertops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:
      a. All deadloads.
      b. 500 pound live load placed on the countertop and vanity.
      c. Deflection at Midspan: L/1000 times span or 1/8 inch (3 mm) whichever is less.

C. Thermal Movements:
   1. Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum range in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss:
      a. Temperature Range: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 SUBMITTALS

A. Product Data: Submit data for miscellaneous metal fabrications and paint, coatings, and grout accessories.

B. Shop Drawings:
   1. Submit shop drawings detailing the fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items:
      a. For installed products indicated to comply with design loads, include structural analysis data, for information only, signed and sealed by the qualified professional engineer responsible for their preparation.

C. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Welding Certificates.

E. Paint Compatibility Certificates: Submit manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Fabricator/Installer Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this work for a minimum of 5 years, with a record of successful in-service performance, with sufficient production capacity to produce required units without causing delay in the work.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated in material, design, and extent.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
   1. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
   2. Provide allowance for trimming and fitting at site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store metal fabrications in a dry, well ventilated, weathertight place. Deliver and handle to prevent any type of damage to the fabricated work.

1.9 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum: AWS D1.2/D1.2M.
      b. Sheet Steel: AWS D1.3/D1.3M.
      c. Stainless Steel: AWS D1.6/D1.6M.
      d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS

A. Metal Surfaces, General:
   1. Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
   2. Slotted Channel Framing: Cold formed metal box channels (struts) complying with MFMA-4.
      a. Size of Channels: 1-5/8 inches by 1-5/8 inches (41 mm by 41 mm).
      b. Material: Galvanized steel ASTM A653/A653M, commercial steel, Type B. with G90 (Z275) coating; 0.108 inch (2.8 mm) nominal thickness.
      c. Cold Formed Metal Channels: Flange edges returned toward web and with 9/16 inch (14.3 mm) wide slotted holes in webs at 2 inches (51 mm) o.c.
      d. Width of Channels: 1-5/8 inches (41 mm).
      e. Depth of Channels: As indicated on Drawings.
      f. Metal and Thickness: Galvanized steel complying with ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108 inch (2.8 mm) nominal thickness.
      g. Finish: Hot dip galvanized after fabrication.
   3. Fasteners: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
      a. Provide stainless steel fasteners for fastening aluminum.
      b. Provide stainless steel fasteners for fastening stainless steel.
      c. Provide stainless steel fasteners for fastening nickel silver.
      d. Provide bronze fasteners for fastening bronze.
      e. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563/A563M; and, where indicated, flat washers.
      f. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A325/ASTM A325M , Type 3; with hex nuts, ASTM A563/A563M, Grade C3 (ASTM A563M, Class 8S3); and, where indicated, flat washers.
      g. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F1554 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy.
      h. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M; and, where indicated, flat washers.

1) Hot dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

i. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M , conducted by a qualified independent testing agency.

j. Cast in Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F2329/2329M.

k. Post Installed Anchors:

1) Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2) Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless steel bolts, ASTM F593 ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

l. Slotted Channel Inserts: Cold-formed, hot-dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts

B. Aluminum:
1. Aluminum Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
2. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
3. Aluminum Alloy Rolled Tread Plate: ASTM B632/B632M , Alloy 6061-T6.
4. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

C. Bronze:
1. Bronze Extrusions: ASTM B455/B455M, Alloy UNS No. C38500 (extruded architectural bronze).
2. Bronze Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).
3. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

D. Cast Iron:
1. Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

E. Nickel:
1. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.
2. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

F. Stainless Steel:
1. Stainless Steel Sheet, Strip, and Plate:ASTM A240/A240M or ASTM A666, Type 304.
2. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
3. Rolled Stainless Steel Floor Plate: ASTM A793.

G. Steel:
1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
3. Steel Tubing: ASTM A500/A500M, cold formed steel tubing.

4. Rolled Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

H. Zinc Coated Steel Wire Rope: ASTM A741:
   1. Wire Rope Fittings: Hot dip galvanized steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

I. Abrasive Surface Floor Plate:
   1. Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel:
      a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
         1) IKG Industries, a division of Harsco Corporation.
         2) SlipNOT Metal Safety Flooring; W.S. Molnar Company.

J. Fasteners:
   1. Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required:
      a. Provide stainless steel fasteners for fastening aluminum.
      b. Provide stainless steel fasteners for fastening stainless steel.
      c. Provide stainless steel fasteners for fastening nickel silver.
      d. Provide bronze fasteners for fastening bronze.
      e. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A307, Grade A with hex nuts, ASTM A563/A563M and, where indicated, flat washers.
      f. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM F3125/F3125M, Type 3 with hex nuts, ASTM A563/A563M, Grade C3 and, where indicated, flat washers.
      g. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F593 with hex nuts, ASTM F594 and, where indicated, flat washers; alloy.
      h. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M and, where indicated, flat washers:
         1) Hot dip galvanize or provide mechanically deposited zinc coating where item being fastened is indicated to be galvanized.
      i. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
      j. Post Installed Anchors:Torque controlled expansion anchors or chemical anchors
         1) Material for interior locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
         2) Material for exterior locations and where stainless steel is indicated: Alloy; Group 1 (A1) or Group 2 (A4), ASTM F593, and nuts, ASTM F594.
      k. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F2329/2329M.
      l. Slotted Channel Inserts: Cold-formed, hot-dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

K. Miscellaneous Materials:
1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D1187/D1187M.
7. Non-shrink, Non-Metallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
8. Concrete Materials and Properties: Composed of ASTM C150/C150M Type I Portland cement, ASTM C33/C33M sand and coarse aggregates and potable water to produce a low slump mix suitable for placement. Grade coarse aggregate from 1/8 inch with at least 95 percent passing a 3/8-inch sieve and not more than 10 percent passing a No. 8 sieve. Fill shall be proportioned to provide a minimum 28-day compressive strength of 3,000 psi (20 MPa).

2.4 FABRICATION

A. Shop Assembly:
1. Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation:
   a. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
   b. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
   c. Form exposed work with accurate angles and surfaces and straight edges.
   d. Weld corners and seams continuously to comply with the following:
      1) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
      2) Obtain fusion without undercut or overlap.
      3) Remove welding flux immediately.
      4) At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
   e. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
   f. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
   g. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

h. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
i. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 inch by 1-1/2 inches (3.2 mm by 38 mm), with a minimum 6 inch (150 mm) embedment and 2 inch (50 mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.
j. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.

2. Miscellaneous Framing and Supports: Provide steel framing and supports necessary to complete the work and which are not a part of the structural framework, including but not limited to framing and supports for elevator hoistway beams, elevator sills, overhead lobby door frames, sliding doors, countertop and vanities, ceiling hung toilet compartments, and tube framing for partial height walls, CMU partition head supports, mechanical and electrical equipment.
   a. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
      1) Fabricate units from slotted channel framing where indicated.
      2) Furnish inserts for units installed after concrete is placed.
   b. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.

2.5 DOWNSPOUT BOOTS

A. Basis of Design:
   1. Model N-6616CX manufactured by J.R. Hoe & Sons,

B. Material: Cast Iron complying with ASTM A48/A48M Class 30 CI.

C. Angle: 90 degrees.

D. Size:
   1. Inlet: 6 by 6 inches.
   2. Overall Height: 16 inches.
   3. Outlet: 5-7/8 inches.

2.6 GUARDS

A. Pipe and Downspout Guards:
   1. Fabricate pipe and downspout guards from 3/8 inch (9.5 mm) thick by 12 inch (300 mm) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with two-inch (50 mm) clearance between pipe and pipe guard. Drill each end for two (2) 3/4-inch (19 mm) anchor bolts.
   2. Galvanize and prime pipe, downspout guards.

2.7 LADDERS

A. Comply with ANSI A14.3. For elevator pit ladders, comply with ASME A17.1/CSA B44

B. Steel Ladders:
   1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
   2. Siderails: Continuous, 1/2 inch by 2-1/2 inch (12.7 mm by 64 mm) steel flat bars, with eased edges.
   3. Rungs: 1 inch (25 mm) 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, either by coating rung with aluminum oxide granules set in epoxy resin adhesive or by using a type of manufactured rung filled with aluminum oxide grout.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
    a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
        1) Harsco Industrial IKG, a division of Harsco Corporation.

2.8 LADDER ACCESS CONTROL DOORS

A. Basis of Design Products:
    1) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
2. 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 (12 mm) in least dimension.

B. Material: 16 gauge galvanized steel.
1. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.

C. Height: 72 inches (1,829 mm).
1. Galvanize ladders, including brackets and fasteners.

D. Width: As required.

E. Hinges:
1. Quantity: 2.
2. Size: 4 by 4 by 1/8 inch (102 by 102 by 3 mm).
3. Material: Galvanized steel.
4. Pin: 1/2 inch (13 mm) diameter.

2.9 MISCELLANEOUS FRAMING AND SUPPORTS

A. Provide steel framing and supports necessary to complete the work and which are not a part of the structural framework, including but not limited to the following:
1. Coiling overhead grille.

B. Fabrication, General:
1. Fabricate from steel shapes, plates, and bars of welded construction unless otherwise indicated.
2. Fabricate to sizes, shapes, and profiles indicated on Drawings and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items:
3. Cut, drill, and tap units to receive hardware, hangers, and similar items.
4. Fabricate units from slotted channel framing where indicated.
5. Provide inserts for units installed after concrete is placed.

2.10 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).

C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).

D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).

E. Maximum Deviation from Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

2.11 FINISHES

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
   1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

2.13 STAINLESS STEEL FINISHES

A. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. Bright, Directional Polish: No. 4 finish.

C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.14 STEEL AND IRON FINISHES

A. Galvanizing:
   1. Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products:
      a. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

D. Preparation for Shop Priming:
   1. Prepare surfaces to comply with requirements indicated below:
      a. Exterior items: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
      b. Items indicated to receive zinc-rich primer: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
      c. Items indicated to receive primers specified in Section 09 96 00 - High-Performance Coatings: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
      d. Other items: SSPC SP3, "Power Tool Cleaning."

E. Shop Priming:
   1. Apply shop primer to comply with SSPC PA1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting:
      a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 EXECUTION

3.1 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

3.2 FIELD CONDITIONS

A. Field Measurements:

1. Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication:
    a. Established dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
    b. Provide allowance for trimming and fitting at site.

3.3 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation, with edges and surfaces level, plumb, true, and free of rack, and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding:
    1. Comply with the following requirements:
        a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
        b. Obtain fusion without undercut or overlap.
        c. Remove welding flux immediately.
        d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection:
    1. Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
        a. Cast aluminum: Heavy coat of bituminous paint.
        b. Extruded aluminum: Two (2) coats of clear lacquer.

3.4 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on shop drawings.

B. Anchor supports for _____ securely to, and rigidly braced from, building structure.

3.5 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch (6mm) per story, noncumulative.

B. Maximum Offset from True Alignment: 1/4 inch (6mm).

C. Maximum Out of Position: 1/4 inch (6mm).

3.6 ADJUSTING AND CLEANING

A. Touchup Painting:
    1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC PA1 for touching up shop painted surfaces:

a. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 90 00 - Painting and Coating.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 50 00

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SECTION 05 51 00 - METAL STAIRS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section includes requirements including but not limited to:
   1. Preassembled steel stairs.
   2. Concrete-filled metal pan stairs.
   3. Accessories necessary for a complete installation.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete.
   2. Section 05 52 00 - Metal Railings: Railings for use with Metal Stairs.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

C. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

F. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2020.

G. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2020a.

H. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.

I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

J. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

K. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

L. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

M. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.

N. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

O. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.

P. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2022.

Q. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

R. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).

S. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

T. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.

U. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2022.

V. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).

W. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

X. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.

Y. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

Z. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

AA. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

BB. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer licensed in the State of Texas and experienced in the design of steel stairs and railings to design stairs and railings.

B. Structural Performance of Stairs:
   1. Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
      a. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
      b. Concentrated load: 300 lbf (1.33 kN) applied on an area of 4 square inches (2580 sq. mm).
      c. Uniform and concentrated loads need not be assumed to act concurrently.
      d. Stair framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
      e. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

C. Accessibility Guidelines:
   1. Treads, Riser, and Nosings:
      a. Interior stairs shall have the upper approach and lower tread marked by a stripe providing clear visual contrast. Exterior stairs shall have the upper approach and all treads marked by a stripe providing clear visual contrast.
      b. Stripe providing clear visual contrast shall be between 2 and 4 inches (51 and 102 mm) wide placed parallel to, and not more than 1 inch (25 mm) from the nose of the step or upper approach. The stripe shall extend the full width of the step or upper approach and shall be of material that is at least as slip resistant as the other treads of the stair. A painted stripe shall be acceptable. Grooves shall not be used to satisfy this requirement.
      c. Radius of curvature at the leading edge of the tread shall be no greater than 1/2 inch (13 mm). Nosings that project beyond riser shall have the underside of the leading edge curved or beveled. The maximum angle for a rise to slope under the tread shall

be 30 degrees from vertical. Nosings shall extend 1-1/4 inch (32 mm) maximum over the tread below.

d. Treads shall be 11 inches (279 mm) deep minimum. Risers shall be between 4 and 7 inches (102 and 178 mm) high. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Open risers are not permitted.

1.5 SUBMITTALS

A. Product Data:
   1. Technical data for metal pan stairs and the following:
      a. Prefilled metal pan stair treads.
      b. Precast concrete treads.
      c. Epoxy resin filled stair treads.
      d. Nonslip aggregates and nonslip aggregate finishes.
      e. Abrasive nosings.
      f. Paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type and finish of nosing and tread.

D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Welding Certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Welding qualifications:
      a. Qualify procedures and personnel according to the following:
         1) AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.

B. Installer Qualifications: Fabricator of products, having minimum of 5 years documented experience in the fabrication and installation of metal stairs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. American Stair Corporation, Inc.: www.americanstair.com.
   2. Lapeyre Stair Inc.: www.lapeyrestair.com.
   3. Pacific Stair Corporation: www.pacificstair.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum: AWS D1.2/D1.2M.
      b. Sheet Steel: AWS D1.3/D1.3M.

c. Stainless Steel: AWS D1.6/D1.6M.
d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

D. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

E. Uncoated, Cold Rolled Steel Sheet: ASTM A1008/A1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

F. Uncoated, Hot Rolled Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

G. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

H. Expanded Metal, Carbon Steel: ASTM F1267, Class 1 (uncoated).

I. Perforated Metal: Cold rolled steel sheet, ASTM A1008/A1008M, or hot rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B.

J. Perforated Metal: Galvanized steel sheet, ASTM A653/A653M, G90 (Z275) coating, commercial steel Type B.

K. Woven Wire Mesh: Intermediate crimp, two-inch (50 mm) woven wire mesh, made from 0.135 inch (3.5 mm) nominal diameter wire complying with ASTM A510/A510M.

L. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

M. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

N. Bronze Extrusions: ASTM B455/B455M, Alloy UNS No. C38500 (extruded architectural bronze).

O. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semi-red brass).

P. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

Q. Fasteners:
1. Provide zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required:
   a. Bolts and Nuts: Regular hexagon head bolts, ASTM A307, Grade A with hex nuts, ASTM A563/A563M and, where indicated, flat washers.
   b. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M and, where indicated, flat washers:
      1) Provide mechanically deposited or hot dip, zinc coated anchor bolts.
   c. Post Installed Anchors:
      1) Torque controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency:
         (a) Material for interior locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

(b) Material for exterior locations and where stainless steel is indicated: Alloy _____ stainless steel bolts, ASTM F593 and nuts, ASTM F594.

R. Miscellaneous Materials:
1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide Series 10 Tnemec Primer by Tnemec.
2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Series 90-97 Tneme-Zinc by Tnemec.
6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D1187/D1187M.
7. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 - Cast-In-Place Concrete for normal weight, air entrained, ready mix concrete with a minimum 28-day compressive strength of 3,000 psi (20 MPa) unless otherwise indicated.
8. Non-Slip Aggregate Concrete Finish: Factory packaged abrasive aggregate made from fused, aluminum oxide grits or crushed emery; rustproof and non-glazing; unaffected by freezing, moisture, or cleaning materials.
9. Welded Wire Reinforcement: 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

2.4 FABRICATION

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure:
1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.5 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing:
   1. Hot dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products:
      a. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
      b. Fill vent and drain holes that are exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3 Power Tool Cleaning.

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1 Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel for shop painting.

PART 3 EXECUTION

3.1 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance rated stair enclosure.

3.2 INSTALLING METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.

F. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 - Cast-In-Place Concrete. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

G. Install precast concrete treads with adhesive supplied by manufacturer.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC PA1 for touching up shop painted surfaces:
   a. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M .

END OF SECTION 05 51 00

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SECTION 05 73 00 - DECORATIVE METAL RAILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Railing and handrail assemblies.
   2. Metal railings.
   3. Pre-fabricated cane detection rails.

B. Related Sections:
   1. Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.

F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

G. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.

H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

K. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.

L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

M. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

N. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

O. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
   1. Contractor.
   2. Manufacturer's representative.
   3. Architect.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Submit manufacturer's product data, including description of materials, components, and finishes.

C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, transitions, and terminations.

D. Samples: Submit one (1) of each item below for each type and condition shown.
   1. Railing: 12-inch (305 mm) long section of handrail showing color, finish and connection detail.

E. Manufacturer's qualification statement.

F. Maintenance Data: Manufacturer's instructions for care and cleaning.

G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer licensed in the State of Texas and experienced in the design of railings, including attachment to building construction.

B. Structural Performance:
   1. Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
      a. Handrails and Top Rails of Guards:
         1) Uniform load of 50 lbf/ft (0.73 kN/m) applied in any direction.
         2) Concentrated load of 200 lbf (0.89 kN) applied in any direction.
         3) Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
      b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements:
   1. Allow for thermal movements from ambient and surface temperature changes:
      a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than fifteen years of documented experience.

1.8 MOCK-UPS

A. Refer tp Section 01 40 00 - Quality Requirements for additional requirements.

B. Provide mock-up of railing system, freestanding center rail, wall-mounted handrail, smoke baffle system, and wind screen system, ____ feet (____ m) long by ____ feet (____ m) wide, indicating each type of material, cladding, and finish.

C. Locate where directed.

D. Mock-up may remain as part of the work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-provided protective coverings and packaging.

B. Protect materials against damage during transit, delivery, storage, and installation at site.

C. Inspect materials upon delivery for damage. Replace damaged items.

D. Prior to installation, store materials and components under cover in a dry location.

1.10 FIELD CONDITIONS

A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C).

B. Maintain ambient temperature of space at minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C) for 24 hours before, during, and after railing installation.

1.11 WARRANTY

A. Warranty: Manufacturer's standard one-year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work:
   1. Architectural Metal Crafts, Inc.: www.archmetalcrafts.com.
   2. Big D Metalworks: www.bigdmetal.com.
   3. Hollaender Manufacturing Co.: www.hollaender.com.
   4. Livers Bronze Co.: www.liversbronze.com.
   5. McNichols.
   6. Salamander Desings: www.salamandercommercial.com.
   7. VIVA Railings, LLC.: www.vivarailings.com.
   8. York Metal Fabricators, Inc.: www.yorkmetal.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum: AWS D1.2/D1.2M.
      b. Sheet Steel: AWS D1.3/D1.3M.
      c. Stainless Steel: AWS D1.6/D1.6M.
      d. Steel: AWS D1.1/D1.1M.

2.3 RAILING SYSTEMS, GENERAL

A. Factory- or shop-fabricate to suit project conditions, for proper connection to building structure, and in largest practical sizes for delivery to site.

B. Handrails: Comply with applicable accessibility requirements listed below:
   1. ADA Standards.

C. Joints: Tightly fitted and secured, machined smooth with hairline seams.

D. Field Connections: Provide sleeves, anchors, and other devices required for site assembly and installation.

E. Welded Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.

2.4 METAL INFILL PANELS

A. Perforated Decorative Metal Railing Infill Panel.
   1. Basis of Design Product:
      a. Products manufactured by McNichols.
   2. Material: Aluminum.
   3. Thickness: 1/8 inch.
   4. Style: As selected by Architect from Manufacturer's full range.
   5. Size: 2'-6" by 2'-6".
   6. Finish: Powder Coat.
      a. Color: As selected by Architect from Manufacturer's full range.
   7. Infill: Manufacturer's perforated metal panels.
   8. Fasteners: Concealed.

2.5 PRE-FABRICATED METAL CANE DETECTION RAILINGS

A. Basis of Design Product:
   1. ADA Rail System One Model AR1/48/SS, AR1/60/SS, AR1/72/SS, AR1/84/SS, or AR1/108/SS, as required manufactured by Salamander Designs.

B. Size:
   1. Height: Refer to Drawings.
   2. Depth: 10 inches (254 mm).
   3. Width: As indicated on Drawings.

C. Material:
   1. 316 stainless steel tubing..
   2. Diameter: 1-1/2 inch (38 mm).
   3. Wall: 0.06 inch (1.5 mm).

D. Finish: Satin.

2.6 MATERIALS AND FINISHES

A. Aluminum Components: ASTM B221 or ASTM B221M.
   1. Clear Anodized Finish: Class I, AAMA 611 AA-M12C22A41, clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils (0.007 inch) (0.018 mm) thick.

B. Steel Components:
   1. Sections, Shapes, Plates, and Bars: ASTM A36/A36M.
   2. Tubing: ASTM A501/A501M structural tubing; round, and shapes as indicated.
   3. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
   4. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
   5. Powder Coat Finish: Manufacturer's recommended system.

C. Stainless Steel Components:
   1. ASTM A666, Type 304 or Type 316.
   2. Stainless Steel Tubing: ASTM A554, Type 304 or Type 316.
   3. Stainless Steel Bars, Shapes, and Moldings: ASTM A276/A276M, Type 304 or Type 316.
   4. Stainless Steel Finish: No.6 Satin.
   5. Powder Coat Finish: Manufacturer's recommended system.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions have been corrected.

E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

3.2 PREPARATION

A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.

B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.3 INSTALLATION

A. Comply with manufacturer's drawings and written instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.

C. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Anchor securely to structure.

E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

F. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, noncumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.5 FIELD QUALITY CONTROL

A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.6 CLEANING

A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements.

B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

3.7 PROTECTION

A. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
   1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION 05 73 00

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SECTION 05 75 00 - DECORATIVE FORMED METAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Edge-protection and transition profiles for floors.
   2. Finishing and edge-protection profiles for walls and countertops.

B. Related Sections:
   1. Section 09 21 16 - Gypsum Board Assemblies.
   2. Section 09 30 00 - Tiling.

1.3 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Warranty.

C. Verification Samples: For each finish product specified, minimum size 6 inches (305 mm) square, representing actual product in color and texture.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Package for protection against transportation damage.
   2. Provide markings to identify components consistently with drawings.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well-ventilated space out of direct sunlight.
   2. Protect from moisture and condensation.
   3. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.6 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. C.R. Laurence Co., Inc.: www.crlaurence.com.
   2. Fry Reglet Corporation: www.fryreglet.com.
   3. Genesis APS International: www.genesis-gs.com.
   4. Schluter Systems: www.schluter.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS

A. Flooring Transition, Type (MT-4):
   1. Basis of Design Product: DILEX-AHKA manufactured by Schluter.
   2. Description: Cove-shaped profile for transitions between walls to be tiled and previously finished floors.
   3. Material and Finish: AE - Satin Anodized Aluminum.
   4. Height: Height as required.
   5. Ramp Length: As required to maintain a slope not greater than one unit vertically in two units horizontally.

B. Flooring Transition, Type (MT-3):
   1. Basis of Design Product: RENO-TK manufactuered by Schluter.
   2. Description: Profile with sloped exposed surface, 1/4 inch (6 mm) deep channel below exposed surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
   3. Material and Finish:AE - Satin Anodized Aluminum.
   4. Height: Height as required.

2.3 FINISHING AND EDGE-PROTECTION PROFILES

A. Decorative Trim, Type (DT-1):
   1. Basis of Design Product: JOLLY manufactuered by Schluter.
   2. Description: L-shaped profile with 1/8 inch (3.2 mm) wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
   3. Anchoring Leg: Provide with straight or special radius anchoring leg as required.
   4. Material and Finish: AT - Satin Nickel Anodized Aluminum.
   5. Height: Height as required.

2.4 MATERIALS

A. Factory Finish:
   1. Clear Anodic Coating: AA-M12C22A41, AAMA 611, Architectural Class I Clear Anodic Coating.

PART 3 EXECUTION

3.1 APPLICATION

A. Consult manufacturer's current technical literature for proper design and installation instructions.

END OF SECTION 05 75 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Rough carpentry, light hardware, and miscellaneous items of work not included in another Section.
   2. Structural wood supports, grounds, backing, and blocking required for millwork and casework items that are an integral part of wall, floor, and/or ceiling construction.
   3. Plywood sheathing.

B. Related Sections:
   1. Section 03 10 00 - Concrete Forming and Accessories.
   2. Section 03 30 00 - Cast-In-Place Concrete.
   3. Section 07 21 00 - Thermal Insulation.
   4. Section 07 92 00 - Joint Sealants.
   5. Section 09 21 16 - Gypsum Board Assemblies.
   6. Section 09 24 00 - Cement Plastering.
   7. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCE STANDARDS

A. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength; 2021.

B. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2018.

1.4 REFERENCES

A. The following references, codes, and standards are hereby made a part of this Section and carpentry work shall conform to applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained in the Drawings or these Specifications shall be construed as permitting work that is contrary to code requirements:
   1. Standard Grading and Dressing Rule #16, of the West Coast Lumber Inspection Bureau.
   2. Grading Rules for Western Lumber of the Western Wood Products Association.
   3. Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service.
   4. American Wood Preservers Association (AWPA) Standard C 2-77 Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes.
   5. American Wood Preservers Bureau (AWPB) Quality Control Standards.

1.5 QUALITY ASSURANCE

A. Lumber and plywood shall be grade or quality marked by WWPA, WCLIB, APA, AWPB, or by other grading and inspection agencies acceptable to the Architect. Grade marks shall include the designation "S-DRY"(or "MC-15" as applies) where applicable. Grade and quality marks shall not be apparent on surfaces exposed in the finished work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store kiln dried materials in enclosed areas, protected from moisture and separated from contact with concrete or soil.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:

B. The following references, codes, and standards are hereby made a part of this Section and carpentry work shall conform to applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained in the Drawings or these Specifications shall be construed as permitting work that is contrary to code requirements:
   1. Standard Grading and Dressing Rule #16, of the West Coast Lumber Inspection Bureau.
   2. Grading Rules for Western Lumber of the Western Wood Products Association.
   3. Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service.
   4. American Wood Preservers Association (AWPA) Standard C 2-77 Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes.
   5. American Wood Preservers Bureau (AWPB) Quality Control Standards.

2.3 MATERIALS

A. Temporary Construction: Clean lumber at Contractor's option, rough or smooth, as usage requires.

B. Lumber Not Otherwise Specified or Noted:
   1. Douglas fir or larch, graded and grademarked, according to Reference Standard 1.02 A or B, #1 grade:
      a. Boards: Construction grade.

C. Plywood for Walls and Roofs; as Indicated on Drawings:
   1. Unless glue type is otherwise specified, exterior plywood, interior plywood exposed to continuing moisture, and pressure treated plywood shall be fabricated with exterior glue. Plywood with interior glue shall be fully protected from soaking or continuing moisture at all times.

D. Rough Hardware:
   1. Nails, spikes, bolts, screws, tacks, and framing connectors of standard manufacture as required. Hot dip galvanize items exposed to moisture or to exterior and those items that are in contact with wood pressure treated with waterborne salts:
      a. Bolts and Nuts: ASTM A307, Grade A.
      b. Lag Bolts: Fed. Spec. FF-B-561. Pre-drill per CBC.
      c. Nails: Fed. Spec. FF-N-101, common unless otherwise noted or specified.
      d. Joist Hangers and Framing Connectors: Simpson or approved equal, unless otherwise noted.
      e. Power Driven Fasteners: Hilti, Ramset, or approved equal, each use and fastener type subject to prior approval by the Architect.

E. Pressure Treatment (Decay and Termite Prevention):
   1. Pressure treat for decay and termite prevention, Douglas fir or larch wood materials that are embedded in or set against concrete.
   2. Treat in accordance with applicable standard
   3. Provide with quality mark per applicable standard.

4. Treat with any of the following processes at the Contractor's option. Creosote type preservatives are not permitted:
   a. Penta in an LPG carrier (Cellon) or Penta in Hydrocarbon Solvent-Type D (Dow Process) AWPB LP-4 quality marked.
   b. Ammoniacal copper arsenate (ACA) or chromated copper arsenate (CCA) in a water carrier (AWPB LP-2 quality marked).
   c. Disodium Octaborate Tetrahydrate (DOT) such as Advance Guard/Hi-bor by Osmose, Inc.
   d. Members treated with waterborne salts shall be dried to a moisture content not exceeding 19 percent after treatment.
5. Where possible, precut material before treatment.
6. Holes and cutoffs and handling and storage shall be in accordance with AWPA M-4.
7. Ensure that ferrous metal fastenings and items in contact with wood treated with waterborne salts are hot dip galvanized (1.25 oz. coating) where required by ICC reports.

F. Framing Connectors: Simpson Strong Tie Corp., or equal.

2.4 MOISTURE CONTENT

A. 19 percent maximum for two times thickness and less; 19 percent maximum for thickness greater than two times and less than four times; and 22 percent maximum for thickness greater than four times.

2.5 SIZES

A. Surfaced to "DRY" sizes. Sizes noted are nominal unless indicated as net.

2.6 SURFACING

A. All wood materials exposed in the finished work shall have re-sawn surfaces of clean natural color unless noted or specified otherwise. Concealed framing lumber shall be S4S.

PART 3 EXECUTION

3.1 ERECTION AND INSTALLATION

A. Framing:
   1. Properly lay out framing with pieces closely fitted, accurately plumbed, leveled and aligned, and rigidly secured in place.

B. Except as specifically shown on structural drawings, cutting of all wood, etc. is limited to those cuts permitted by applicable Building Code.

C. Bridging and Blocking:
   1. Provide two times blocking at intersections of finished surfaces for adequate bearing and at points where required to support fixtures, cabinets, hardware, and other equipment mounted on walls.

D. Plywood (General): Unless more stringent requirements are indicated on the Drawings or required by code, application of plywood shall be in accordance with recommendations of the American Plywood Association.

E. Connections and Fastenings:
   1. For bolted connections, provide washers under heads and nuts bearing on wood, and draw nuts tight. Retighten before closing in framing.
   2. Exercise care in nailing through exposed sheathing and siding and ensure that fasteners penetrate into framing members

END OF SECTION 06 10 00

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SECTION 06 16 00 - SHEATHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section includes:
   1. Wall sheathing.
   2. Underlayment.
   3. Sheathing joint and penetration treatment.
   4. Accessories necessary for a complete installation.

B. Related Sections:

1.3 REFERENCE STANDARDS

A. ASME B18.6.1 - Wood Screws (Inch Series); 1981 Edition, 1981.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

D. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board; 2020.

E. ASTM C834 - Standard Specification for Latex Sealants; 2017.

F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2020.

G. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

H. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials; 2012 (Reapproved 2020).

I. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).

J. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.

K. ASTM D5516 - Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures; 2018.

L. ASTM D6305 - Standard Practice for Calculating Bending Strength Design Adjustment Factors for Fire-Retardant-Treated Plywood Roof Sheathing; 2021.

M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

N. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

O. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples; 2021a.

P. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.

Q. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

R. PS 1 - Structural Plywood; 2023.

1.4 SUBMITTALS

A. Product Data:
   1. Technical data for each type of process and factory fabricated product. Indicate component materials and dimensions and include construction and application details:
      a. Include data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
      b. Include data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
      c. For fire retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
      d. For products receiving a waterborne treatment, include statement that moisture content of treated materials reduced to levels specified before shipment to Project site.
   2. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 QUALITY ASSURANCE

A. Fire Test Response Characteristics:
   1. For assemblies with fire resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction:
      a. Fire Resistance Ratings: Indicated by design designations from UL Fire Resistance Directory or GA-600 Fire Resistance Design Manual.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Preservative Treated Plywood:
      a. Georgia Pacific: www.gp.com.
   2. Wall Sheathing:
      a. CertainTeed Corporation: www.certainteed.com.
      b. Georgia Pacific: www.gp.com.
      c. National Gypsum Company: www.nationalgypsum.com.
      d. United States Gypsum Co.: www.usg.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

C. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.2 MATERIALS

A. Plywood: DOC PS 1 .

B. Thickness: As necessary to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: 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.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE RETARDANT TREATED PLYWOOD

A. Where fire retardant treated materials are indicated, use materials complying with requirements acceptable to authorities having jurisdiction and with fire test response characteristics specified determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire Retardant Treated Plywood by Pressure Process:
   1. Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test:
      a. Use treatment that does not promote corrosion of metal fasteners.
      b. Exterior type: Treated materials shall comply with requirements specified above for fire retardant treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
      c. Design value adjustment factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high temperature fire retardant treatment is indicated, span ratings for temperatures up to 170 degrees F (76 degrees C) shall be not less than span ratings specified.

C. Kiln dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire retardant treated plywood with appropriate classification marking of qualified testing agency.

E. Application:
   1. Treat plywood indicated on Drawings and the following:
      a. Roof and wall sheathing within 48 inches (1,220 mm) of fire walls.
      b. Subflooring and underlayment for raised platforms.

2.5 WALL SHEATHING

A. Glass Mat Gypsum Wall Sheathing - ASTM C1177/C1177M:
   1. Basis of Design Product:
      a. GlasRoc manufactured by CertainTeed Corporation.
      b. Dens-Glass manufactured by Georgia Pacific.
      c. Gold Bond eXP manufactured by National Gypsum Company: .

d. Securock manufactured by United States Gypsum Co.
2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.
3. Size: 4 by 8 feet (1,220 by 2,440 mm) for vertical installation.

2.6 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor Underlayment: DOC PS 1, Exterior, Structural I, C-C Plugged Single Floor Panels:
1. Span Rating: Not less than 20 inches (508 mm) o.c.
2. Nominal Thickness: Not less than 1 inch (25 mm).
3. Edge Detail: Tongue and groove.
4. Surface Finish: Fully sanded face.

B. Underlayment: Provide underlayment in nominal thickness not less than 1/4 inch (6 mm) over smooth subfloors and not less than 3/8 inch (10 mm) over board or uneven subfloors.

C. Sound Deadening Board: Class C Fire Rated, Molded, Recycled Post-Consumer Paper, Cellulose Fiber Structural Panel:
1. Density: 26 to 28 pcf (416 to 448 kg/cu. m) tested in accordance with ASTM C209.
2. Tensile strength when tested in accordance with ASTM C209:
a. Parallel: 450 to 700 psi (3100 to 4830 kPa).
b. Transverse: 750 to 1000 psi (5.1 to 6.9 kPa).
3. Hardness (Janka Ball): 230 pounds (104 kg) tested in accordance with ASTM D1037.
4. Water absorption by volume, when tested in accordance with ASTM C209:
a. Two-hour immersion: Maximum seven percent (7%).
5. Expansion: 50 percent to 90 percent relative humidity, 0.25 percent in accordance with ASTM C209.
6. Noise reduction coefficient (NCR): 0.20.
7. Flame spread: Maximum 75 tested in accordance with ASTM E84 Class C.
8. Thickness: 3/4 inch (19 mm).

2.7 FASTENERS

A. Provide fasteners of size and type indicated that comply with requirements specified for material and manufacture. Provide fasteners with hot dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667/F1667M.

C. Power Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Gypsum Sheathing to Cold Formed Metal Framing:
1. Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic polymer or corrosion protective coating having salt spray resistance of more than 800 hours according to ASTM B117:
a. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.

2.8 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS

A. Sealant for Glass Mat Gypsum Sheathing:
1. Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass fiber sheathing tape and for covering exposed fasteners:
a. Sheathing tape: Self-adhering glass fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass mat gypsum sheathing and with history of successful in-service use.

2.9 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 EXECUTION

3.1 INSTALLATION

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than 3 support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint sealant installation so materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-216 and with manufacturer's written instructions. Fasten gypsum sheathing to cold formed metal framing with screws. Install boards with a 3/8 inch (10 mm) gap where non-load bearing construction abuts structural elements. Install boards with a 1/4 inch (6 mm) gap where they abut masonry or similar materials that retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Vertical Installation:
   1. Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud:
      a. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (10 mm) from edges and ends of boards.

D. Seal sheathing joints according to sheathing manufacturer's written instructions. Apply glass fiber sheathing tape to glass mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal penetrations and openings.

END OF SECTION 06 16 00

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SECTION 06 20 00 - FINISH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Providing all finish carpentry items including, but not limited to:
      a. Finish carpentry.
      b. Millwork and cabinetry.
      c. Plastic laminate.
      d. Casework hardware.
      e. Miscellaneous millwork.
   2. Installation of:
      a. Finish hardware.
      b. Plastic laminate faced wood doors.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry.
   2. Section 13 34 23.14 - Fabricated Classroom Buildings.

1.3 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

D. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

F. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

G. BHMA A156.9 - Cabinet Hardware; 2020.

H. KCMA A161.1 - Performance and Construction Standard for Kitchen and Vanity Cabinets; 2017.

I. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer’s preprinted product information for all hardware proposed on the Project.
   3. Manufacturer’s preprinted maintenance instructions for the casework hardware.

B. Shop Drawings:
   1. Indicate size, material, and finish.
   2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim, and other pertinent data for each unit.

C. Certification: Provide manufacturer’s certification that casework has been fabricated and installed according to WI “Custom” Grade guidelines or better.

D. Samples: Two each, 6 inches by 6 inches by 3/4 inch (152 mm by 152 mm by 19 mm) sample of specified particleboard core with grade stamp for use as verification of installed product.

E. Closeout:
   1. Record drawings: Indicate revisions to original Drawings and shop drawings.
   2. Manufacturer contact names, addresses, and phone numbers.
   3. Finish material schedule: Names and color numbers of laminates and stains.
   4. Keys: Provide additional master key for each room and additional locksets totaling one percent (1%) of total Project for attic stock.

1.5 PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated, perform work in accordance with WI “Architectural Woodwork Standards,” Custom Grade, except where specification exceeds those standards the more stringent shall govern.

B. Fabricate millwork and cabinetry in accordance with KCMA A161.1, NEMA LD 3, and general static load testing performed and certified by an independent testing agency covering the following areas of product performance, with these minimum results:
   1. Base cabinet construction/racking test: 800 pounds (363 kg).
   2. Cabinet front joint loading test: 425 pounds (193 kg).
   3. Wall cabinet static load test: 2,000 pounds (907 kg).
   4. Drawer front joint loading test: 600 pounds (272 kg).
   5. Drawer construction/static load test: 750 pounds (340 kg).
   6. Cabinet adjustable shelf support device/static load test: 300 pounds (136 kg).

C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

1.6 QUALITY ASSURANCE

A. Manufacturers and fabricators must be Woodwork Institute listed Accredited Millwork Companies, current roster.

B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.

C. Installer Qualifications: Licensee of WI's Certified Compliance Program.

D. Quality Standard:
   1. Unless otherwise indicated, comply with WI's "Manual of Millwork" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements:
      a. Before delivery to jobsite, millwork supplier:
         1) Licensees of WI shall issue a certified compliance certificate indicating millwork products being furnished for this Project, and certifying that these products and their installation, will fully meet requirements of grade or grades specified.
         2) Non-licensees of WI shall provide evidence that they have arranged for inspection by WI inspector after completion of fabrication and installation. If conditions are found to be compliant, inspector will issue Compliance Certificate indicating millwork products being furnished for this Project and certifying that these products and their installation will fully meet requirements of grade or grades specified.
      b. Each elevation of casework and each countertop shall bear certified compliance label.
      c. Cabinet Design Series (CDS): CDS numbers on Drawings indicate typical designs.

E. Pre-Installation Conference:
   1. Refer to Section 01 31 00 - Project Management and Coordination.

1.7 WARRANTY

A. Warranty the work specified herein for 5 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include but not be limited to the following:
   1. Rough or difficult operation, or loose or missing parts.
   2. Delamination of surfaces.
   3. Noticeable deterioration of finish.
   4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver completed laminate clad casework, countertops, and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.

B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Plastic Laminate:
      a. Abet Laminati, Inc: abetlaminati.com.
      b. Formica Corporation: www.formica.com.
      c. Panolam Industries International Inc: panolam.com/hpl-high-pressure-laminate.
      d. Wilsonart, LLC: www.wilsonart.com.
   2. Millwork Fabricators:
      a. Calmar Manufacturing Co., Inc., a subsidiary of Imperial Woodworking Company: www.calmarmanufacturing.com.
      b. Case Systems, Inc.: www.casesystems.com.
      c. Global Casework Manufacturing, Inc.: www.globalcasework.com.
      d. Jericho Woodworks: www.jericho-woodworks.com.
      e. MGC, Inc.: www.mgcinc.net.
      f. Robert Shaw Mfg. Co., Inc.:
      g. Stevens Industries, Inc.:www.stevensind.com.
      h. Terrill Manufacturing Co.: www.terrillmfg.com.
      i. TMI Systems Design Corp.: www.tmisystems.com.
      j. Woodwork Institute listed Accredited Millwork Companies, current roster, this shall not preclude the Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project.
   3. Hardware:
      a. Doug Mockett & Company, Inc.: www.mockett.com.
      b. Grass America: www.grassusa.com.
      c. Hafele North America Co.: www.hafele.com.
      d. Julius Blum & Co., Inc.: www.juliusblum.com.
      e. Knape & Vogt: www.knapeandvogt.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2. Welding Qualifications: Qualify procedures and personnel according to the following:
   a. Aluminum: AWS D1.2/D1.2M.
   b. Sheet Steel: AWS D1.3/D1.3M.
   c. Stainless Steel: AWS D1.6/D1.6M.
   d. Steel: AWS D1.1/D1.1M.

2.3 MILLWORK MATERIALS

A. Core Material:
   1. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
   2. Medium-density fiberboard: ANSI A208.2, Grade MD.
   3. Plywood: Shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted. Plywood allowed at countertops and toe-base only.
   4. Water resistant treated plywood shall have 24 hour thickness swell factor of 5 percent or less and 24 hour water absorption factor of 10 percent or less; P.S. 51, Type II or better.
   5. Cabinet components shall be of the following minimum core thicknesses:
      a. Cabinet Backs, Drawer Body, and Drawer Bottoms:1/2 inch (13 mm) particleboard.
      b. Door and Drawer Face, Base, Wall, and Tall Cabinet Tops and Bottoms, Cabinet Sides, Drawer Spreaders, Cabinet Back Rear Hangstrips, Structural Dividers, and Exposed Cabinet Backs: 3/4 inch (19 mm) particleboard.
      c. Work Surfaces and Countertops: Minimum 1 inch (25 mm) particleboard or plywood. Use water resistant treated plywood core at counters with sinks.
      d. Shelves: 3/4 inch (19 mm) particleboard core for 30 inches (762 mm) long or less, 1 inch (25 mm) thick particleboard core for more than 30 inches (762 mm) long; 14 inch (356 mm) deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches (914 mm) long.
      e. Cabinet Toe-Base: 3/4 inch (19 mm) plywood. No particleboard within 3 inches (76 mm) of floor.

B. Countertops:
   1. Refer to Section 12 36 00 - Countertops.

C. Toe Spaces:
   1. Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.

D. End Panels and Filler Strips:
   1. Match adjacent case-piece.

E. Edging:
   1. Provide the following in accordance with “Edging Locations:”
      a. Flat-Edge PVC: 0.020 inch (0.5 mm). Solid, high-impact, purified, color-through, acid resistant, machine-applied with hot melt adhesives.
      b. 1/8 inch (3 mm) PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8 inch (3 mm) radius.
   2. Edging Locations:
      a. Cabinet body edge, including door/drawer front spacer rail:
         1) Flat edge PVC, color as selected by the Architect.
      b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body:
         1) Flat edge PVC to match cabinet interior surface color.
      c. Door/drawer-front edging:
         1) 1/8 inch (3 mm) PVC, color matched to standard laminates.

2.4 CABINET HARDWARE

A. All hardware shall meet BHMA A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner:

B. Hinges:
   1. Heavy duty, five-knuckle 2-3/4 inch (70 mm) institutional type hinge complying with BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch (2.4 mm) thick. Each hinge shall have minimum of 9 screws, #7, 5/8 inch (16 mm) FHMS to assure positive door attachment.
   2. One pair per door to 48 inches (1,219 mm) height. One and one-half pair over 48 inches (1,219 mm) in height. Hinge shall accommodate 13/16 inch (21 mm) thick laminated door and allow 270-degree swing.
   3. Finish: US26D.

C. Pulls:
   1. 4 Inch Wire:
      a. Wire design, 4 inches (102 mm) long.
      b. Finish: atin chrome, US26D finish.

D. Drawer Slides:
   1. Standard drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100 pound (45 kg) dynamic load rating at full extension.
   2. File drawers: Full extension, three-part progressive opening slide, precision steel ball bearing, minimum 100 pound (45 kg) dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.
   3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
   4. Paper storage drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150 pound (68 kg) dynamic load rating at full extension.

2.5 SOLID STOCK

A. Moisture Content: Percent of moisture in relation to over-dry weight shall be between eight percent (8%) and 13 percent at time of installation.

2.6 MISCELLANEOUS

A. Utility Shelving: WI "Economy" grade.

2.7 MILLWORK FABRICATION

A. Use the WI Custom Grade woodwork classification unless noted elsewhere complying with referenced quality standard.

B. Fabricate casework and related products to dimensions, profiles, and details shown on Drawings. Fabricate casework square, plumb, and true.

C. Detailed Requirements for Cabinet Construction:
   1. Toe-Base:
      a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor.
      b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch (6 mm) from face of finished end for flush installation of finished base material.
      c. No cabinet sides-to-floor will be allowed.
   2. Cabinet Top and Bottom:
      a. Solid sub-top shall be furnished for all base and tall cabinets.
      b. At cabinets over 36 inch (914 mm), bottoms and tops shall be mechanically joined by a fixed divider.
      c. Assembly devices shall be concealed on bottom side of wall cabinets.
   3. Cabinet Sides:

a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
b. Drill holes for adjustable shelves 1-1/4 inches (32 mm) on center.

4. Cabinet Backs:
   a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
   b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two at base, two at wall, and three at tall cabinets as instructed by casework manufacturer.
   c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on Drawings.
5. Exposed end corner and face frame attachment:
   a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
6. Door and Drawer Fronts:
   a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
   b. Where indicated, provide stile and rail doors with full 1/4 inch (6 mm) plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
   c. Where indicated, frameless sliding glass doors shall be 1/4 inch (6 mm) thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.

D. Drawers:
1. Drawer fronts: Apply to separate drawer body component sub-front.
2. Drawer sides: Doweled to receive front and back, glued under pressure, machine squared.
3. Drawer bottom: Set into front and sides, 1/4 inch (6 mm) deep groove with minimum 3/8 inch (19 mm) standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch (13 mm) by 4 inches (102 mm) front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches (610 mm), two at 36 inches (914 mm), and over.
4. Paper Storage Drawers: Fitted with full width hood at back.
5. Hanging file drawers shall be fabricated to accept letter size hanging folders compatible with Pendaflex system.

E. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.

F. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.

G. Typical Desk or Counter Height at Knee Space Locations: 30 inches (762 mm) A.F.F.

PART 3 EXECUTION

3.1 JOB CONDITIONS

A. Environmental Requirements:
1. Do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week:
   a. Manufacturer/supplier shall advise the Contractor of temperature and humidity requirements for architectural casework installation areas.
   b. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.

B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

3.2 COORDINATION

A. Coordinate the work of this Section with plumbing work specified in Division 22. Coordinate sink opening construction with sinks specified in Division 22 or as indicated on Drawings.

B. Coordinate location of blocking in walls for installation and support of wall cabinets.

3.3 MILLWORK INSTALLATION

A. Positioning: Place approximately level, plumb, and at right angles to adjacent work.

B. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.

C. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.

D. Fasten tops to frames with concealed clips, screws, and glue.

E. Install simulated wood trim in locations shown on Drawings and in accordance with manufacturer's instructions.

3.4 EXISTING DOOR LAMINATE RESURFACING

A. Resurfacing procedures shall be in accordance with the recommendations and instructions of the laminate and adhesive manufacturers.

B. Acclimate laminate to the same environment as existing material at least 48 hours. Perform work in well-ventilated area, out of the way of construction dust and traffic to maintain clean adhesion.

C. Clean the substrate with detergent or non-flammable solvent as instructed by laminate manufacturer to remove wax, grease, and polish deposits.

D. Using a belt sander or sander instructed by manufacturer, sand entire surface to remove original finish. Remove sanding dust thoroughly.

E. Coat the sanded surface and back of laminate with a uniform coating of contact adhesive. Allow to dry thoroughly prior to assembling. Assembling wet adhesive lines will trap solvent and may result in poor bonding. Follow the adhesive manufacturer's instructions.

F. Index the laminate with the substrate. Make initial contact by smoothing with palms. Apply pressure using a "J" roller or rotary press. Allow to set as instructed by adhesive manufacturer to achieve full adhesion to maintain warranty. Trim with recommended tools.

G. Apply laminate to door faces and exposed vertical edges. Apply edges before face. Paint top and bottom edges to color match facing.

H. Coordinate hardware and vision lite cutouts with work of other Sections.

3.5 FINISH HARDWARE INSTALLATION

A. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.

B. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by the Contractor at their expense.

C. Provide clean, properly sized, and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.

D. Fit all surface-applied hardware accurately.

E. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.

F. Remove all finish hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.

G. Millwork the Contractor shall be responsible for hardware on millwork.

3.6 PLASTIC LAMINATE FACED WOOD DOOR INSTALLATION

A. Protect all doors during handling.

B. Install doors in accordance with manufacturer’s instructions.

C. Install and adjust doors for smooth, quite operation.

D. Refer to Section 08 71 00 - Door Hardware where applicable.

END OF SECTION 06 20 00

SECTION 07 05 43 - CLADDING SUPPORT SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Cladding support systems, directly attached to substrates.
   2. Cladding support systems, insulation penetrating.
   3. Cladding support systems, dual systems.
   4. Concealed lintel system.

B. Related Requirements:
   1. Section 03 30 00 - Cast-in-Place Concrete.
   2. Section 04 20 00 - Unit Masonry.
   3. Section 05 40 00 - Cold Formed Metal Framing.
   4. Section 06 10 00 - Rough Carpentry.
   5. Section 07 21 00 - Thermal Insulation.
   6. Section 07 27 26 - Fluid-Applied Membrane Air Barriers.
   7. Section 07 42 13 - Metal Wall Panels.

1.3 ABBREVIATIONS AND ACRONYMS

A. FRP: Fiber-reinforced polymer.

B. PVDF: Polyvinylidene Fluoride.

C. Zn-Al-Mg: Zinc-Aluminum-Magnesium.

1.4 DEFINITIONS

A. Continuous Insulation: As defined by ASHRAE Std 90.1 I-P.

1.5 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

C. ACMA (FRP) - Guidelines and Recommended Practices for Fiber-Reinforced-Polymer (FRP) Architectural Products; 2016.

D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

F. ASTM A1046/A1046M - Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process; 2022.

G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

H. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus; 2019.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

J. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.6 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate cladding support system manufacturer's requirements with requirements of exterior structural wall assemblies.

B. Preinstallation Meetings:
   1. Schedule meeting to occur after final approval of submittals by the Architect.
   2. Agenda: Review exterior structural wall assembly requirements and cladding fastening requirements.
   3. Required Attendees: The Contractor, cladding support system subcontractors and cladding subcontractors.
   4. Invited Attendees: the Owner's Designated Representative (ODR) and the Architect.

1.7 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's published descriptive data, including product attributes.
   1. Include data for cladding support system.

C. Shop Drawings: For each cladding support system; indicate:
   1. Sections: Include column centers, elevations, and dimensions; indicate locations of system components, component spacings, and wall fasteners.
      a. Drawing Scale: 1/8 inch to 1 foot (1:100), minimum.
   2. Details: Connection details between cladding support systems and substrates; indicate fastener size and spacing.
      a. Drawing Scale: 1-1/2 inches to 1 foot (1:10), minimum.

D. Certificate: Certify cladding support systems of this section meet or exceed specified design criteria.

E. Delegated Design Documents: Submit for information, signed and sealed documents by structural engineer of record responsible for comprehensive design package of cladding system, including wall fasteners and anchors. Submit structural design, rail spacing, and calculations sufficient to comply with structural design criteria of this section.

F. Design Data: Submit for information, project-specific thermal performance values for above-grade walls; prepared by professional engineer; substantiate values based on alternative compliance methods described in ASHRAE Std 90.1 I-P and acceptable by AHJ.

G. Test Reports: Submit test reports for each type of cladding support system performed by qualified testing agency for manufacturer.

H. Manufacturer's Instructions: Submit manufacturer's written installation instructions.

I. Specimen warranty.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience and approved by manufacturer.

C. Documents at Project Site: Maintain at project site one copy of manufacturer's installation instructions and shop drawings.

1.9 MOCK-UPS

A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.

B. Construct exterior wall assembly mock-up, including cladding support systems as indicated on Drawings.

C. Construct cladding support system mock-up, 12 feet (3.7 m) long by 8 feet (2.4 m) high.
   1. Include cladding support system, exterior structural wall assembly, and wall anchors.

D. Locate as indicted on Drawings.

E. Mock-up may remain as part of work.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

B. Deliver products to project site in wrapped, protected, unbroken packaging with product identification labeling.

C. Store products under cover and elevated above grade.

D. Handle products without damaging; prevent bending, warping, and twisting to surfaces, edges, or corners.

1.11 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty against structural failure of cladding support system. Complete forms in Owner's name and register with manufacturer.

C. Manufacturer's Special Warranty: Provide 10-year warranty for cladding support system components, including structural failure of components, commencing on Date of Substantial Completion. Complete forms in the Owner's name and register with warrantor.

D. Installer Warranty: Provide 2-year warranty against installation defects commencing on Date of Substantial Completion. Complete forms in the Owner's name and register with installer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
   1. Advanced Architectural Products, LLC: www.smartcisystems.com.
   2. Cladiator: www.cladiator.com.
   3. Hohmann & Barnard, Inc: www.h-b.com.
   4. Knight Wall Systems: www.knightwallsystems.com.
   5. Northern Facades: www.northernfacades.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

C. Source Limitations: Provide complete cladding support system including wall fasteners and wall anchors from single manufacturer.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 BASIS OF DESIGN

A. HB RS EZclad Rainscreen Support System manufactured by Hohmann & Barnard, Inc.

2.4 PERFORMANCE CRITERIA

A. Surface Burning Characteristics: Provide cladding support systems with a flame spread index (FSI) of 25 or less, and a smoke developed index (SDI) of 450 or less, when tested in accordance with ASTM E84 or UL 723.

B. Fire Propagation Requirements of Exterior Wall Assemblies: Tested in accordance with, and comply with, the acceptance criteria of NFPA 285.

2.5 DESIGN CRITERIA

A. Refer to Section 01 40 00 - Quality Requirements for additional information.

B. Structural Design Services: Provide the Contractor's design-related professional services for structural design of cladding support systems based on the following criteria:
   1. Design Loads: Exterior wall design loads as indicated on structural drawings.
   2. Fastener Design Criteria: Minimum safety factor of three for both tension and shear values.
   3. Thermal Movement Design Criteria: Cladding systems allow for thermal movements without overstressing components and evidence of permanent component defects, based on maximum ambient temperature of 120 degrees F (49 degrees C).

C. Thermal Performance Design Services: Provide the Contractor's design-related professional services for thermal performance design of cladding support systems:
   1. Design Criteria: Provide cladding support systems that, when combined with thermal performance of continuous insulation and other exterior wall assembly components, provide building envelope wall assemblies that meet minimum energy efficiency requirements of ASHRAE Std 90.1 I-P.
   2. For assembly U-factors determined by testing, provide design based on values in accordance with ASTM C1363.

2.6 EXTERIOR WALL ASSEMBLIES WITH CLADDING SUPPORT SYSTEMS

A. Cladding: Refer to Section 07 42 13 - Metal Wall Panels.

B. Depth of Air-Gap Cavity: As indicated on Drawings.

C. Cladding Support System Applications:
   1. Direct-attached-to-substrate cladding support systems.
   2. Insulation-penetrating cladding support systems.
   3. Dual-system cladding support systems.

D. Exterior Continuous Thermal Insulation:
   1. Refer to Section 07 21 00 - Thermal Insulation.
   2. Depth of Insulation: As indicated on Drawings.

E. Water-Resistive Barriers: Refer to Section 07 27 26 - Fluid Applied Air Barrier Systems.

F. Vapor Retarders: Refer to Section 07 27 26 - Fluid-Applied Air Barrier Systems.

G. Air Barriers: Refer to Section 07 27 26 - Fluid-Applied Air Barrier Systems.

H. Sheathing: Refer to Section 06 16 00 - Sheathing.

I. Exterior Structural Wall Assemblies: Refer to Sections 03 30 00 - Cast-in-Place Concrete, 04 20 00 - Unit Masonry, 05 40 00 - Cold Formed Metal Framing, and 06 10 00 - Rough Carpentry.

2.7 CLADDING SUPPORT SYSTEMS, DIRECTLY ATTACHED TO SUBSTRATE

A. Perforated Metal, Hat-Shaped, Cladding Attachment Rails:
   1. Basis of Design Products:
      a. PanelRail manufactured by Knight Wall Systems.
   2. Description: Square-shaped hat channels perforated with vent holes; hat-shape faces outward; flanges with stiffening lips and fastener attachment holes.
   3. Attachments to Substrate: Manufacturers recommended anchors fasten rails to substrates through attachment holes of flanges.

4. Applications:
    a. Direct-attached-to-substrate cladding support systems; attaches directly to exterior structural wall assemblies.
    b. Secondary system in dual-system cladding support systems; attached to and installed outboard of primary cladding support system.
5. Material: Zn-Al-Mg-coated steel sheet.
6. Depth: 3/4 inch (19 mm).
7. Thickness: 18 gauge, 0.048 inch (1.2 mm).
8. Flange Width: Two equal flanges, each 1 inch (25 mm) wide, nominal.
9. Face Width and Total Width Including Flanges:
10. Orientation in Direct-Attached-to-Substrate Applications: As indicated on Drawings.
11. Spacing: In accordance with Contractor -provided structural design.

B. Perforated Metal, Inverted-Hat-Shaped, Cladding Attachment Rails:
1. Basis of Design Products:
    a. RevealRail manufactured by Knight Wall Systems.
2. Description: Square-shaped hat channels perforated with vent holes; hat-shape faces inward to form reveals; flanges with stiffening lips and fastener attachment holes.
3. Attachments to Substrate: Manufacturers recommend anchors fasten rails to substrates through attachment holes of flanges.
4. Applications:
    a. Direct-attached-to-substrate cladding support systems.
    b. Secondary system in dual-system cladding support systems; attached to and installed outboard of primary cladding support system.
5. Material: Zn-Al-Mg-coated steel sheet.
6. Depth: 3/4 inch (19 mm).
7. Thickness: 18 gauge, 0.048 inch (1.2 mm).
8. Flange Width: Two equal flanges, each 1 inch (25 mm) wide, nominal.
9. Inverted Face Width and Total Width Including Flanges:
    a. Inverted Face Width: 2 inches (51 mm); total width: 5-1/8 inches (130 mm).
10. Orientation in Direct-Attached-to-Substrate Applications: As indicated on Drawings.
11. Spacing: In accordance with Contractor -provided structural design.

C. Cladding Attachment Rails with Brackets:
1. Basis of Design Products:
    a. FlexBracket manufactured by Hohmann & Barnard, Inc.
2. Description: Rails attached to substrate with adjustable brackets; designed to receive cladding and attachment clips.
3. Applications:
    a. Direct-attached-to-substrate cladding support system in orientation indicated on drawings.
    b. Secondary system in dual-system cladding support system; attached to and installed outboard of primary cladding support system.
4. Rails: Aluminum, L-shaped, with 2-3/8-inch (60 mm) long leg and 1-9/16-inch (40 mm) short leg.
    a. Thickness: 8 gauge, 0.128 inch (3.26 mm).
    b. Spacing: In accordance with Contractor -provided structural design.
5. Brackets: Stainless steel; shimmed to ensure thermal isolation.

2.8 CLADDING SUPPORT SYSTEMS, INSULATION PENETRATING

A. Z-Shaped, Thermally Improved Systems:
1. Basis of Design Products:
    a. ThermaZee manufactured by Knight Wall Systems.

2. Description: Z-shaped, thermally improved, perforated steel rails with hollow-core, extruded plastic, thermal isolation strips along back of rails; rails penetrate continuous insulation.
3. Attachments to Substrate: Manufacturers recommend wall fasteners attach rails to steel-framed exterior wall assemblies through attachment holes of inboard face of Z-shaped rails.
4. Applications:
   a. Insulation-penetrating cladding support systems.
   b. Primary system in dual-system cladding support systems; installed inboard of secondary system.
5. Material: Zn-Al-Mg-coated steel sheet.
6. Depth: As indicated on Drawings.
7. Thickness: 18 gauge, 0.048 inch (1.2 mm).
8. Outward Face Width: As required to meet performance requirements.
9. Orientation: As indicated on Drawings.
10. Rail Spacing: In accordance with Contractor -provided structural design.

B. Z-Shaped, Thermally Improved Fiber-Reinforced Polymer (FRP) Girts With Steel Inserts:
1. Basis of Design Products:
   a. SMARTci GreenGirt manufactured by Advanced Architectural Products, LLC.
2. Description: Z-shaped, FRP girts with outboard and inboard faces; reinforced with integral, continuous, zinc-coated, steel sheet inserts.
3. Attachment to Substrate: Girts penetrate continuous insulation; wall fasteners attach inboard faces of girts to steel-framed exterior wall assemblies.
4. Rigid Foam Insulation Applications:
   a. Zinc-coated steel sheet splines to stabilize insulation panels.
5. Steel Inserts and Splines: Zinc-coated steel sheets.
6. Girt Depth: As indicated on Drawings.
7. Girt Outboard Face Dimension: 1.49 inch (38 mm).
8. Girt Inboard Face Dimension: 1.78 inch (45 mm).
9. Orientation: As indicated on Drawings.
10. Rail Spacing: In accordance with Contractor -provided structural design.

C. Box-Shaped Metal Rail Systems:
1. Basis of Design Products:
   a. CI System manufactured by Knight Wall Systems.
2. Description: Box-shaped metal rails mounted over rigid foam plastic continuous insulation; wall fasteners penetrate insulation and attach to steel-framed exterior structural wall assemblies.
3. Applications:
   a. Insulation-penetrating cladding support systems.
   b. Primary system in dual-system cladding support systems; installed inboard of secondary system.
4. Material: Zn-Al-Mg-coated steel sheet.
5. Depth: 3/4 inch (19 mm).
6. Thickness: 18 gauge, 0.048 inch (1.2 mm).
7. Face Width: 2 inches (51 mm).
8. Orientation: As indicated on Drawings.
9. Spacing: In accordance with Contractor -provided structural design.

D. Hat-Shaped, Metal Rail Systems:
1. Basis of Design Products:
   a. HCI System manufactrued by Knight Wall Systems.
2. Description: Square-shaped hat-channel rails perforated with vent holes; flanges with stiffening lips and fastener holes.

3. Applications:
   a. Insulation-Penetrating Cladding Support Systems: Channel flanges mount over rigid foam plastic exterior continuous insulation; wall fasteners penetrate insulation and attach to steel-framed exterior structural wall assemblies.
   b. Primary system in dual-system cladding support systems; installed inboard of secondary system.
4. Material: Zn-Al-Mg-coated steel sheet.
5. Depth: 3/4 inch (19 mm).
6. Thickness: 18 gauge, 0.048 inch (1.2 mm).
7. Flange Width: Two equal flanges, each 1-5/8 inch (41.3 mm) wide.
8. Face Width: 2 inches (51 mm).
9. Total Width: 5-1/4 inches (133 mm).
10. Orientation: Horizontal.
11. Spacing: In accordance with Contractor -provided structural design.

E. Bracket-and-Rail Systems:
1. Basis of Design Products:
   a. MFI System manufactured by Knight Wall Systems.
2. Description, Primary Components:
   a. Thermally isolated wall brackets attached to steel-framed wall assemblies.
   b. Metal rails installed outboard of wall brackets.
3. Attachments to Substrate: Brackets penetrate insulation; manufacturers recommend wall fasteners attach rails to steel-framed exterior wall assemblies through attachment holes of inboard face of brackets.
4. Wall Brackets: Preassembled assemblies composed of polyoxymethylene, thermal-isolating base plates, formed steel brackets, and stem isolators.
   a. Bracket Assembly Dimensions:
      1) Base Width: 2-1/8 inches (53.98 mm), minimum.
      2) Base Height: 3-1/8 inches (79.38 mm), minimum.
      3) Steel Bracket Thickness:14 gauge, 0.074 inch (1.9 mm) sheet steel.
      4) Assembly Depth Including Static Rail: 5-3/4 inches (146 mm), nominal.
      5) Assembly Depth Including Dynamic Rail: 5-1/2 inches (140 mm), nominal.
   b. Steel Bracket Material: Zn-Al-Mg-coated steel sheet.
   c. Bracket Spacing: In accordance with Contractor-provided structural design.
   d. Rail Orientation: As indicated on Drawings.
   e. Rail Spacing: In accordance with Contractor -provided structural design.
5. Metal Rails: C-shaped, cold-formed steel channels with flanges of equal width; prepunched holes in flanges at 1 inch (25 mm) on center for attachment to brackets.
   a. Material: Zn-Al-Mg-coated steel sheet.
   b. Thickness:18 gauge, 0.046 inch (1.17 mm), minimum.
   c. Channel Nominal Width: 1 inch (25 mm), minimum.
6. Rail to Bracket Connection: Fixed.
7. Spacing: In accordance with Contractor -provided structural design.

2.9 CLADDING SUPPORT SYSTEMS, DUAL SYSTEMS

A. Description: Cladding support systems composed of primary and secondary systems; secondary system attached to and outboard of primary system.

B. Locations: Where indicated on Drawings.

C. Inboard Primary Systems:
1. Description: Thermally improved, insulation-penetrating, cladding support rails; attached to steel-framed wall assemblies; supports secondary cladding support system.
2. Material: Zn-Al-Mg-coated steel sheet.
3. Depth: As indicated on Drawings.

4. Thickness:18 gauge, 0.048 inch (1.2 mm).
5. Rail Orientation: As indicated on Drawings.
6. Outward Face Width: In accordance with Contractor-provided structural design.
7. Spacing: In accordance with Contractor-provided structural design.

D. Outboard Secondary Rail Systems:
1. Description: Attached to and outboard of primary rail support systems.
2. Material: Zn-Al-Mg-coated steel sheet.
3. Depth: 3/4 inch (19 mm).
4. Thickness: In accordance with Contractor -provided structural design.
5. Orientation: As indicated on drawings.
6. Outward Face Width: In accordance with Contractor -provided structural design.
7. Spacing: In accordance with Contractor -provided structural design.

2.10 CONCEALED LINTEL SYSTEM

A. Basis of Design:
1. Concealed Lintel Systems manufactued by Hohmann & Barnard, Inc.

B. Design: Lintel system to be designed by a structural engineer to meet the requirements indicated on Drawings.

C. Material: Stainless Steel.

D. Lintel Style: As indicated on Drawings.

E. Soffit Style: As indicated on Drawings.

F. Size: As indicated on Drawings.

2.11 MATERIALS

A. Zinc-Aluminum-Magnesium (Zn-Al-Mg)-Coated Steel Sheet:
1. ASTM A1046/A1046M, Designation SS, Grade 50, Class 2; Coating Designation ZM40.
2. Thickness: 18 gauge, 0.048 inch (1.2 mm).
3. Finish: Superior performing organic coatings complying with AAMA 2605, multiple coats, thermally cured polyvinylidene fluoride system; finish one side only.
a. Color: Black.

B. PVDF-Coated Steel Sheet:
1. ASTM A1046/A1046M, Designation SS, Grade 50, Class 2; Coating Designation ZM40.
2. Thickness: 18 gauge, 0.148 inch (1.2 mm).
3. Finish: Superior performing organic coatings, thermally cured polyvinylidene fluoride system complying with AAMA 2605; finish one side only.

C. Zinc-Coated Steel Sheet:
1. Galvanized G90 coating designation; in accordance with ASTM A653/A653M.

D. Fiberglass Reinforced Polymer (FRP):
1. Polyester resin matrix with recycled materials and fire-retardant additives; reinforced with glass strand rovings for longitudinal strength and continuous strand glass mats or stitched reinforcements for transverse strength.

E. Sheet Aluminum: ASTM B209/B209M, 6063 alloy, T6 temper.
1. Class I Clear Anodized Finish: AAMA 611 AA-M12C22A41, clear anodic coating, minimum 0.7 mil, 0.007 inch (0.018 mm) thick.

2.12 FABRICATION

A. Shop fabricate to greatest extent possible.

2.13 ACCESSORIES

A. Miscellaneous Non-Structural Accessories: Provide non-structural accessories; flashings, sealants, tapes, and shims as recommended by manufacturer, suitable for project-specific applications, and compatible with system components.

B. Miscellaneous Structural Metal Accessories: For metal accessories under superimposed structural loads, provide corrosion-resistant-coated steel bracing, furring, and clips in accordance with Contractor-provided structural design of cladding system.

C. Metal Accessories: Provide transition units as recommended by manufacturer, suitable for project-specific applications, and compatible with system components.

D. Miscellaneous Thermal Isolation Accessories: Manufacturer's thermoplastic shims that do not decrease thermal or structural system performance, thickness, shape, and structural compressive strength suitable for project-specific applications.

E. Fasteners Between Claddings and Cladding Support Systems:

F. Wall Anchors:
   1. Manufacturer's corrosion-resistant-coated steel wall anchors with recommended washers for anchoring cladding support systems to concrete structural wall assemblies.
      a. Thermal Performance: Manufacturer's wall anchors with thermally isolated polymer washers.

G. Wall Fasteners:
   1. Manufacturer's corrosion-resistant-coated steel wall fasteners for attaching cladding support systems to steel-framed structural wall assemblies.
      a. Structural Performance: Manufacturer's wall fasteners; type, spacing, and embedment in accordance with Contractor-provided structural design of cladding system.
      b. Thermal Performance: Manufacturer's wall fasteners with thermally isolated polymer washers.
   2. Cold-Formed Steel Substrates: Manufacturer's recommended self-tapping metal screws.
   3. Wood-Frame Substrates: Manufacturer's recommended wood screws.

H. Thermal Isolation Clips: Thermally broken clips providing attachment support for girts, angles, channels, and other cladding support framing.
   1. Thermal Spacer Clip: Polyamide resin.
      a. Thickness: 3/16 inch (4.8 mm) at top, base, and web.
   2. Galvanized Steel Support Clip: 14 gauge, 0.0747 inch (1.9 mm), G90 (Z275) galvanized support clip complying with ASTM A653/A653M, with integral glass-fiber-reinforced polyamide thermal isolator pad.
   3. Stainless Steel Support Clip: 16 gauge, 0.0625 inch (1.59 mm), type 304 stainless steel with thermal isolator pad.
   4. Clip Depth: As required for thickness of insulation.
   5. Clip Spacing: 16 inches (406 mm) on center, vertically.
   6. Fasteners: As recommended by clip manufacturer.
   7. Basis of Design Products:
      a. ISO Clip manufactrued by Northern Facades.

I. FRP-Steel Attachments: Comply with ACMA (FRP).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Verify substrates comply with Contract Documents, including specified tolerances, and are ready to receive work of this section.
   2. Verify air barrier, wall flashing, and rigid insulation work comply with Contract Documents.

B. Do not commence installation until non-compliant conditions have been corrected.

3.2 PREPARATION

A. Protection of In-Place Conditions: Protect air barrier work from damage.

B. Surface Preparation:
   1. Prepare substrate surfaces using methods in accordance with cladding support system manufacturer's written instructions.

3.3 INSTALLATION

A. Installation of Cladding Support System Substrates.
   1. Refer to Section 03 30 00 - Cast-in-Pace Concrete for installation of concrete wall substrates.
   2. Refer to Section 04 20 00 - Unit Masonry for installation of concrete masonry wall substrates.
   3. Refer to Section 05 40 00 - Cold Formed Metal Framing for installation of cold-formed, steel-stud framing wall substrates.

B. Install cladding support systems in accordance with Contractor -provided structural design.

C. Installation of Wall Anchors in Concrete Wall Substrates: Install anchors in accordance with Contractor -provided structural design.

D. Installation of Wall Fasteners in Cold-Formed Metal Framing Wall Substrates: Install fasteners in accordance with Contractor -provided structural design.

E. Installation of Secondary System Fasteners to Primary Cladding System Substrates: Install fasteners in accordance with Contractor -provided structural design.

3.4 TOLERANCES

A. Install cladding support systems plumb with noncumulative maximum variation of:
   1. 1/4 inch in 20 feet (1 mm in 1 m).

B. Install cladding support systems level with noncumulative maximum variation of:
   1. 1/4 inch in 20 feet (1 mm in 1 m).

3.5 FIELD QUALITY CONTROL

A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.

B. Manufacturer Services: Provide services of manufacturer's field representative to inspect installation of cladding support systems.

3.6 CLEANING

A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements.

3.7 PROTECTION

A. Protect installed cladding support systems from subsequent construction operations.

END OF SECTION 07 05 43

SECTION 07 16 00 - BELOW GRADE WATERPROOFING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Preparation of concrete surfaces to receive waterproofing membrane.

B. Sealing of cracks and joints.

C. Fluid applied waterproofing system, with prefabricated drainage composite or protection board at walls that fall below grade (auditorium, basement, elevator pit, etc.).

D. Pre-applied waterproofing system, with joint sealing tape, and other accessories at below grade horizontal surfaces under the slab or elevator pit.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-In-Place Concrete

B. Section 07 92 00 - Building Sealants

C. Division 23 - Mechanical: Mechanical penetrations, such as floor drains and piping, through waterproofing membrane.

D. Division 26 - Electrical: Electrical penetrations, such as conduit, through waterproofing membrane.

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. Certifications:
1. Manufacturers certification that applicator is approved by Manufacturer.
2. Manufacturer’s affidavit that materials used in Project contain no asbestos.

C. Warranty: Submit a sample warranty identifying the terms and conditions stated in warranty.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Applicator shall be experienced in applying the same or similar materials and shall be specifically approved in writing by the membrane system Manufacturer.

B. Regulatory Requirements: Comply with applicable codes, regulations, ordinances, and laws regarding use and application of products that contain volatile organic compounds (VOC).

1.5 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials job site in original, factory-sealed, unopened containers bearing Manufacturer's name and label intact and legible with following information.
   1. Name of material.
   2. Manufacturer's stock number and date of manufacture.
   3. Material safety data sheet (MSDS).

B. Store and handle in strict compliance with Manufacturer’s instructions, recommendations and material safety data sheet (MSDS).

C. Protect from damage from sunlight, weather, excessive temperatures and construction operations.

D. Remove damaged material from the site and dispose of in accordance with applicable regulations.

E. Do not double-stack pallets of waterproofing on the job site. Provide cover on top and all sides.

F. Store drainage composite and protection board flat and off the ground. Provide cover on top and all sides.

G. Protect waterproofing materials from freezing. In cool temperatures, store the material for several hours at room temperature to facilitate mixing and application.

H. Sequence deliveries of materials to avoid delays but minimize on-site storage.

1.7 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the Manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.

C. Coordinate waterproofing work with other trades to ensure adequate illumination, ventilation, and dust-free environment during application and curing of membrane. The applicator shall have sole right of access to the specified areas for the time needed to complete the application and allow the membrane to cure adequately.

D. Protect adjoining surfaces not to be coated against damage or soiling. Protect plants, vegetation and animals which might be affected by waterproofing operations.

E. Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.

F. Keep products away from spark or flame. Do not allow the use of spark producing equipment during application and until all vapors have dissipated. Post "NO SMOKING" signs.

G. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

1.8 WARRANTY

A. Warrant the work specified herein for ten (10) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.

PART 2 - PRODUCTS

2.1 FLUID APPLIED WATERPROOFING SYSTEM - POST APPLIED

A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. AVM Industries, Inc. Canoga Park, CA (AVM Aussie Membrane 500)
2. Carlisle Coatings and Waterproofing Incorporated, Wylie, TX (Barricoat)
3. GCP Applied Technologies, Cambridge, MA (Procor)
4. W. R. Meadows, Inc., Hampshire, IL (Mel-Rol LM)

B. Fluid Applied Waterproofing Membrane: Water-based rubber and / or bitumen liquid / fluid applied waterproofing membrane modified with high performance rubberized polymers and special additives for use in vertical seamless applications.

Waterproofing Membrane Physical Properties, minimum:

Property	Test Method	Typical Value
Cured / Dry Film Thickness	ASTM D3767	60 mils
Solids Content	---	62%
Low Temp Flexibility	ASTM C836	Pass
Elongation	ASTM D412	500%
Pliability	ASTM D1970	Unaffected
Resistance to Standing Water	ASTM D2939	Pass

C. Accessory Products:
1. Protection Coarse: Prefabricated drainage composite material designed to promote positive drainage while serving as a protection course. Provide product consisting of an impermeable polymeric sheet cuspated under heat and pressure to form a high flow dimpled drainage core with a bonded layer of nonwoven filter fabric.

D. Locations: Vertical below-grade structural concrete foundation walls opposite conditioned and habitable areas that fall below grade 0'-0" and where shown on drawings.

2.2 SHEET APPLIED WATERPROOFING SYSTEM - POST APPLIED

A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Carlisle Coatings and Waterproofing Incorporated, Wylie, TX (MiraDRI 860/861)
2. W. R. Meadows, Inc., Hampshire, IL (Mel-Rol)

B. Sheet Applied Waterproofing Membrane: Self-adhering sheet membrane consisting of rubberized asphalt laminated to a polyethylene film.

Waterproofing Membrane Physical Properties, minimum:

Property	Test Method	Typical Value
Thickness	ASTM D3767	60 mils
Low Temp Flexibility	ASTM D1970	Pass
Elongation	ASTM D412	350%
Puncture Resistance	ASTM E154	50 lbf
Hydrostatic Head	ASTM D5385	230 ft

C. Accessory Products:
1. Primer: Manufacturer's recommended spray or roller applied water-based adhesive.
2. Detail Sealant: Manufacturer's recommended sealant material for use at penetrations, cut edges, top edge terminations, transitions, etc. and adhesion for the protection course.
3. Detail Strip: Manufacturer's recommended waterproofing membrane material.
4. Protection Coarse: Prefabricated drainage composite material designed to promote positive drainage while serving as a protection course. Provide product consisting of an impermeable polymeric sheet cuspated under heat and pressure to form a high flow dimpled drainage core with a bonded layer of nonwoven filter fabric.
5. Termination Bar: High strength, pre-formed, multi-purpose plastic strip with holes 6" o.c.

D. Locations: Vertical and horizontal below-grade structural concrete foundation walls opposite conditioned and habitable areas that fall below grade 0'-0" and where shown on drawings.

2.3 SHEET APPLIED WATERPROOFING SYSTEM - PRE-APPLIED

A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. AVM Industries, Inc. Canoga Park, CA (AVM Aussie Skin 550G)
2. GCP Applied Technologies, Cambridge, MA (Preprufe 200)

B. Sheet Waterproofing Membrane: Composite sheet comprising a heavy duty, puncture resistant, HDPE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating. Membrane provides a continuous seal that resists water ingress and migration between the membrane and the structure.

C. Accessory Products:
1. Pressure Sensitive Tape: Two-sided, reinforced, pressure sensitive tape constructed with a highly aggressive adhesive. Material to form a continuous and integral seal to the structure (GCP Prefrufe CJ Tape).
2. Detail Sealant: Manufacturer's approved sealant intended for use sealing around penetrations.

D. Locations: Vertical below-grade structural concrete foundation walls opposite conditioned and habitable areas as well as horizontal surfaces below the slab that fall below grade 0'-0" and where shown on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before waterproofing work is started the all surfaces to be waterproofed shall be thoroughly examined for all deficiencies. Should deficiencies exist, the Architect shall be notified in writing and corrections made.

3.2 SURFACE PREPARATION

A. Surfaces to which waterproofing is to be applied shall be thoroughly clean, dry and free from all surface contaminates or cleaning residue that may harmfully affect the adhesion of the membrane.

B. Repair all cracks in accordance with Manufacturer’s instructions.

3.3 APPLICATION

A. Priming: Shall be in accordance with membrane Manufacturer's instructions.

B. Apply waterproofing in accordance with membrane Manufacturer's instructions.

C. Liquid membrane waterproofing on vertical walls shall positively overlap turned up sheet membrane waterproofing from under slab as instructed by the Manufacturer.

D. Where shown or required, install specified perimeter drainage system as the first course of drainage composite immediately after membrane has cured on vertical surfaces. Install Manufacturer’s recommended drainage composite or protection board / protection course on remainder.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Polyisocyanurate foam plastic board.
   2. Glass mineral fiber blanket.
   3. Accessories necessary for a complete installation.

B. Related Sections:
   1. Section 05 40 00 - Cold Formed Metal Framing: Exterior framing.
   2. Section 06 10 00 - Rough Carpentry.

1.3 REFERENCE STANDARDS

A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

C. ASTM C727 - Standard Practice for Installation and Use of Reflective Insulation in Building Constructions; 2019.

D. ASTM C764 - Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation; 2019.

E. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2021.

F. ASTM C1321 - Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCS) in Building Construction; 2015.

G. ASTM C1744 - Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Commercial/Industrial Building Construction; 2019.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

J. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C; 2022.

K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Technical data and installation instructions for each type of insulation product specified.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's Installation Instructions.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization
      a. Surface Burning Characteristics: Per ASTM E84.
         1) Flame Spread Index: Maximum 25.
         2) Smoke Developed Index: Maximum 450.
      b. Fire Resistance Ratings: Per ASTM E119.
      c. Combustion Characteristics: Non-combustable per ASTM E136.
   2. Underwriter's Laboratories UL 723 Tests for Surface Burning Characteristics of Building Materials.

B. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of work.
   1. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.

C. Environmental Requirements:
   1. Manufacture extruded polystyrene with HCFC or other CFC free blowing agents. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected:
      a. Wherever possible, provide boards from manufacturers who recycle insulation materials.
   2. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect Foam Plastic Board Insulation:
   1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
   3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.7 PROJECT CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

B. Sequence work to ensure fireproofing and firestop materials are in place before beginning work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. CertainTeed Corporation: www.certainteed.com/building-insulation.
   2. DuPont de Nemours, Inc.: www.dupont.com.
   3. Hunter Panels: www.hunterpanels.com.
   4. Johns Manville; a Berkshire Hathaway company: www.jm.com.
   5. Kingspan Group:www.kingspan.com/us/en.
   6. Knauf Insulation: www.knaufinsulation.com.

7. Owens Corning: www.owenscorning.com/en-us/insulation/commercial.
8. Rmax, a subsidiary of the Sika Corporation: www.rmax.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
1. Code Standards:
a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 POLYISOCYANURATE FOAM PLASTIC BOARD

A. Polyisocyanurate Board, Foil Faced: ASTM C1289, foil faced, Type I, Class 1 or 2.
1. Basis of Design Products:
a. Thermax manufactured by DuPont de Nemours, Inc.
b. Xci manufactured by Hunter Panels.
c. ECOMAXci manufactured by Rmax, Inc.
2. Fire Propagation Characteristics: Pass NFPA 285 testing as part of an approved assembly.

2.4 GLASS MINERAL FIBER INSULATION

A. Glass Mineral Fiber Batt, Unfaced: ASTM C665, Type I (unfaced); with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
1. Basis of Design Products:
a. CertaPro manufactured by CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. EcoBatt with ECOSE manufactured by Knauf Insulation.
d. PINK Next Gen Fiberglas manufactured by Owens Corning.

B. Glass Mineral Fiber Batt, Kraft Faced: ASTM C665 , Type II (nonreflective faced), Class A (faced surface with a flame spread index of 25 or less); Category 1 (membrane is a vapor barrier).
1. Basis of Design Products:
a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. EcoBatt with ECOSE manufactured by Knauf Insulation.
d. PINK Next Gen Fiberglas manufactured by Owens Corning.

2.5 INSULATION FASTENERS

A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Plate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

B. Adhesively Attached, Angle Shaped, Spindle Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Angle: Formed from 0.030 inch (0.762 mm) thick, perforated, galvanized carbon steel sheet with each leg 2 inches (50 mm) square.

2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

C. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
   1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
      a. Crawl spaces.
      b. Ceiling plenums.
      c. Attic spaces.

D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.6 ACCESSORIES

A. Insulation for Miscellaneous Voids:
   1. Glass Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame spread and smoke developed indexes of 5, per ASTM E84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Board and Batt Insulation: Install insulation that is undamaged, dry, and unsoiled and has not been exposed to ice, rain, or snow at any time.
   1. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Do not seal joints in board insulation. Remove projections that interfere with placement.
   2. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

C. Cavity Wall Insulation: Foam Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
   1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 05 00 - Common Work Results for Masonry.
   2. Cellular Glass Board Insulation: Install with closely fitting joints using attachment method according to manufacturer's written instructions.

D. Framed Construction, Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3 inch (76 mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal framed wall cavities where cavity heights exceed 96 inches (2,438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   a. Glass Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu ft (40 kg/cu m) .
   b. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

E. Curtain Wall: Install board insulation in curtain wall construction according to curtain wall manufacturer's written instructions.
1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
2. Install insulation to fit snugly without bowing.

F. Reflective Insulation: Install sheet reflective insulation according to ASTM C727.
1. Install sheet radiant barriers according to ASTM C1744.
2. Install interior radiation control coating system according to ASTM C1321.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

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SECTION 07 27 26 - FLUID APPLIED AIR BARRIER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Fluid-applied air barrier membrane in exterior wall assemblies.

B. Materials to bridge and seal the following air leakage pathways and gaps:
   1. Connections of the walls to the roof air barrier.
   2. Connections of the walls to the foundation air barrier.
   3. Seismic and expansion joints.
   4. Openings and penetrations of window frames, storefront, curtain wall and mechanical, electrical and plumbing systems.
   5. Barrier precast concrete and other envelope systems.
   6. Door frames.
   7. Piping, conduit, duct and similar penetrations.
   8. Masonry ties, screws, bolts and similar penetrations.
   9. All other air leakage pathways in the building envelope.

C. Related Work in other Sections includes but is not limited to the following:
   1. Section 01 45 00 – Quality Control
   2. Section 01 50 00 – Temporary Facilities and Controls
   3. Section 03 30 00 – Cast-In-Place Concrete
   4. Section 04 20 00 – Unit Masonry
   5. Section 07 65 00 – Flexible Flashing
   6. Section 07 90 00 – Joint Sealants
   7. Section 09 21 16 – Gypsum Wallboard Systems (Exterior Sheathing)

1.3 PERFORMANCE REQUIREMENTS

A. Material Performance: Provide air barrier materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm / ft2 @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).

B. Provide materials with a water vapor permeance of 10.0 US perms or greater, determined in accordance with ASTM E96 Water method (Procedure B).

C. Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.04 cfm/ft2 @ 1.57 psf) when tested in accordance with ASTM E2357. The assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations.

   1. The air barrier assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement, and shall transfer the load to the structure.

2. Fluid applied air barriers shall not displace adjacent materials in the air barrier assembly under full load.
3. The air barrier assembly shall be joined in an airtight and flexible manner to the air barrier materials of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.

D. Connections to Adjacent Materials: Provide connections to prevent air leakage at the following locations:

1. Foundation and walls, including penetrations, ties and anchors.
2. Walls, windows, curtain walls, storefronts, louvers or doors.
3. Different wall assemblies, and fixed openings within those assemblies.
4. Wall and roof connections.
5. Floors over unconditioned space.
6. Walls, floor and roof across construction, control and expansion joints.
7. Walls, floors and roof to utility, pipe and duct penetrations.
8. Seismic and expansion joints.
9. All other potential air leakage pathways in the building envelope.

1.4 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination

1.5 SUBMITTALS

A. Submittals: Submit in accordance with Division 1 requirements.

B. Installer Qualifications: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America's (ABAA). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).

C. Product Data: Submit material Manufacturer's Product Data, material Manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, Technical Data, and tested physical and performance properties.

1. Submit letter from primary air barrier material Manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that Manufacturer's material.
2. Include statement from the primary air barrier material Manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.

D. Samples: Submit clearly labeled samples, three (3) inch by four (4) inch minimum size of each material specified.

E. Field Test Results of Mock-Up: Submit test results of air leakage test and water leakage test of mock-up in accordance with specified standards, including retesting if initial results are not satisfactory.

F. Compatibility: Submit letter from primary material Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.

1.6 QUALITY ASSURANCE

A. Air Barrier Installer Qualifications: Air barrier Subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA).

1. Fluid-applied membrane air barrier Installer(s) shall be certified in accordance with the requirements outlined by ABAA. Installers shall have their photo identification air barrier certification cards in their possession and available on the project site, for inspection upon request.

B. Manufacturer: Obtain primary ABAA Evaluated Materials from a single ABAA Evaluated Manufacturer regularly engaged in manufacturing specified fluid-applied membranes. Obtain secondary materials from a source acceptable to the primary materials Manufacturer.

C. Accredited Laboratory Testing for Materials: Laboratory accredited by International Accreditation Service Inc. (IAS), American Association for Laboratory Accreditation (A2LA), or the Standards Council of Canada (SCC).

D. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.

E. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction of mock-up, sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction and chemical/fire safety plans. Attendance is required by the Fluid Applied Air Barrier System Manufacturer’s field representative, representatives of related trades including covering materials, substrate materials and adjacent materials.

F. Mock-Ups: Build mock-up representative of primary air barrier assemblies and glazing assemblies including backup wall and typical penetrations as acceptable to the Architect. Mock-up shall be dimensioned no less than eight (8) feet long by eight (8) feet high and include the air barrier materials and air barrier accessories proposed for use in the exterior wall assembly. The mock-ups shall remain visible and intact for the duration of the fluid applied air barrier system work scopes. Mock-ups shall be suitable for field testing.

G. Mock-Up Tests for Air and Water Infiltration: The General Contractor shall provide testing of the window and door opening(s) in the mock-up for air and water infiltration. The testing shall be in accordance with AAMA 501.2 (hand wand field testing), If deficiencies are found, the air barrier Contractor shall reconstruct mock-up at their cost for retesting until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.

H. Air Barrier Assembly Testing: Verify air barrier assembly testing by the material Manufacturer by visiting the ABAA website to ensure an ASTM E2357 test has been completed and to obtain results. Visit the ABAA website for the reported air barrier assembly leakage rate and illustrations or CAD details which includes the methods in which the assembly test mock-ups shall be assembled.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with material Manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material Manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.

C. Handle materials in accordance with Manufacturer's recommendations.

1.8 PROJECT CONDITIONS

A. Temperature: Install fluid-applied air barrier material within range of ambient and substrate temperatures recommended by material Manufacturer. Do not apply air barrier to a damp or wet substrate.

B. Field Conditions: Do not install air barrier in snow, rain, fog, or mist. Do not install air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the Manufacturer.

C. Sequencing: Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.

D. Compatibility: Do not allow air barrier materials to come in contact with chemically incompatible materials.

E. Ultra-violet exposure: Do not expose air barrier materials to sunlight longer than as recommended by the material Manufacturer.

1.9 WARRANTY

A. Material Warranty: Provide Manufacturer's standard product warranty, for a minimum 20 years from date of Substantial Completion.

B. Subcontractor (approved by ABAA and Manufacturer) Installation Warranty: Provide a five (5) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fluid Applied Membrane Air Barrier: Use regular, high temperature or low-temperature formulation depending on site conditions, within temperature ranges specified by Manufacturer. Subject to compliance with requirements, provide one of the following:

1. Henry Company: Air Bloc 17MR at 48 mils (wet) - *Medium build option*. www.henry.com:

   a. AIR BARRIER MATERIAL PROPERTIES:

      1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft^2 @ 1.57 psf), at 48 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 28 US perms at 25 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

   b. AIR BARRIER ACCESSORY MATERIALS:

      1) Liquid Applied Flashing: Air-Bloc LF.

2) Transition Membrane: Blueskin SA and Blueskin SALT for low-temperature applications.
3) Sheathing Joint Membrane: Blueskin VP160.
4) Spray Adhesive: Blueskin Adhesive and Blueskin LVC Adhesive.
5) Water-Based Primer for Transition Membrane: Aquatac Primer.
6) Counterflashing for Metal Panel Through-Wall Flashing: Blueskin TWF.
7) Sealant: HE 925 BES Sealant.
8) Reinforcing Tape: HE 183 Yellow Glass Fabric.
9) Insulation Adhesive: Air-Bloc 21.

2. Protecto Wrap: Protecto Wall Liquid Air Barrier VP by at 10 mils (dry). www.protectowrap.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.00086 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000864 cfm/ft2 @ 1.57 psf), 0.0043 liters per square meter per second under a pressure differential of 75 Pa (0.0043 L/(s·m2) @ 75 Pa)] at 10 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 660.8 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (660.8 ng/(Pa·s·m^2) [11.5 US perms] at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Water-Based Primer: Universal Water Based Primer.
2) Solvent-Based Primer: BT Primer.
3) Solvent-Based Aerosol Primer: Protecto-Tak Spray Adhesive.
4) Sealants: Protecto Wall Board to Baord Joint Sealant.
5) Transition Membrane for details and terminations: Protecto Wall Transition Tape.
6) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BT Primer.
7) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Universal Water Based Primer.
8) Substrate Joint Treatment: Protecto Wall Board to Board Joint Sealant.

3. Sika Corporation: Sikagard 530 Liquid Applied Vapor Permeable Air Barrier at 30 mils (dry). www.sika.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being < 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (< 0.0001 cfm/ft^2 @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m^2) / 11.5 US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Water-Based Primer: Sikagard 530.
2) Solvent-Based Primer: Sikagard 510.
3) Termination Mastic: Sikaflex 11FC.
4) Sealants: Sikaflex 11FC.
5) Transition Membrane for details and terminations: SikaMultiSeal 515.
6) Reinforcing/Joint Tape: SikaMultiSeal 515.
7) Counterflashing for Through-Wall Flashings: SikaMultiSeal Plus with Flexible Flashing.
8) Through-Wall Flashings or Shelf Angle Flashings: SikaMultiSeal Plus below the flexible through wall flashing system.
9) Substrate Joint Treatment: Sikaflex 11FC.

4. STS Coatings: Wall Guardian FW-100-A (Acrylic-based component) 40 mils (wet), 20 mils (dry). www.wallguardian.com:

   a. AIR BARRIER MATERIAL PROPERTIES:

      1) Air permeance for this material has been tested and reported as being 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft^2 @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m^2) / 11.5 US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

   b. AIR BARRIER ACCESSORY MATERIALS:

      1) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: None.
      2) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BP-40 Primer for use with UT-40 Universal Tape.
      3) Through-Wall Flashings or Shelf Angle Flashings: Gorilla Flash VF-1000.
      4) Mastics: None.
      5) Adhesives and Tapes: Universal Tape UT-40, a butyl based tape and Great Seal LT-100, a low voc elastomeric sealant for deflection joints and details.
      6) Transition Strip: Universal Tape, UT-40.
      7) Termination Mastic: Great Seal LT-100.
      8) Window Flashing and Detail Membrane: Universal Tape UT-40.

5. Tremco, Inc.: ExoAir 230 at 40 mils (wet) www.tremcosealants.com

   a. AIR BARRIER MATERIAL PROPERTIES:

      1) Air permeance for this material has been tested and reported as being 0.0003 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0003 cfm/ft^2 @ 1.57 psf), at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 1677 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1677 ng/(Pa·s·m^2) at 29 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Solvent Based Primer: ExoAir Primer
2) Termination Mastic: ExoAir Termiantion Mastic
3) Sealants: Tremflex 834, Dymonic 100, Spectrem 1
4) Transition Membrane for Details and Terminations: ExoAir 110, ExoAir 111, ExoAir TWF, Dymonic 100
5) Reinforcing / Joint Tape: Tremco 2011 mesh
6) Flashing at Transition Membrane: ExoAir 111, ExoAir TWF, Dymonic 100
7) Counterflashing for Through Wall Flashings: ExoAir TWF
8) Through Wall Flashings or Shelf Angle Flashings: ExoAir TWF below the flexible through wall flashing system.
9) Solvent Based Primer for Flashing, Transition Strip and Detail Membrane: ExoAir Primer
10) Substrate Joint Treatment: Tremflex 834, Dymonic 100 depending on substrate.

6. W.R. Meadows, Inc.: Air-Shield LMP, at 60 mils (wet), 30 mils (dry). www.wrmeadows.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.000096 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000096 cfm/ft2 @ 1.57 psf), [0.00048 liters per square meter per second under a pressure differential of 75 Pa (0.00048 L/(s·m2) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 598 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (598 ng/(Pa·s·m^2) [10.47 US perms] at 30 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Water-Based Primer: None required for Air Shield LMP.
2) Solvent-Based Primer: None required for Air Shield LMP.
3) Solvent-Based Aerosol Primer: None required for Air Shield LMP.
4) Termination Mastic: Pointing Mastic or BEM.
5) Transition Membrane for details and terminations: Air Shield.
6) Reinforcing / Joint Tape: Reinforcing Fabric HCR.
7) Flashing at Transition Membrane: Air Shield Thru-Wall Flashing.
8) Counter-flashing for Through-Wall Flashings: Air Shield Thru-Wall Flashing.
9) Through-Wall Flashings or Shelf Angle Flashings: Air Shield Thru-Wall Flashing below the flexible through wall flashing system.
10) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime VOC.
11) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime WB.
12) Substrate Joint Treatment: Air Shield Joint Filler.

2.2 AUXILIARY MATERIALS

A. Transition Membrane Between Air and Vapor Barrier Membrane and Roofing and Other Adjacent Materials: Comply with both air barrier Manufacturer's recommendations and roofing material Manufacturer's recommendations.

B. Provide primers, glass fabric scrim tape, mastic, and other materials not specifically described, but required for a complete and proper installation as instructed by the air barrier system Manufacturer or required to provide a continuous the air barrier assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The ABAA Certified Air Barrier Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with ABAA Certified Installer present, for compliance with requirements.

1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
2. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
3. Ensure that the following conditions are met:
    a. Surfaces are sound, dry, even, and excess mortar and / or other contaminants.
    b. Inspect and confirm substrates to be smooth and without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the substrate Subcontractor.
    c. Inspect and confirm masonry joints to be reasonably flush and completely filled, and ensure all excess mortar accumulated on masonry ties has been removed. Inform General Contractor if masonry joints are not acceptable and need to be repaired by the masonry Subcontractor.
    d. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
4. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test.
5. Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
6. Notify Architect in writing of anticipated problems using air and vapor barrier over substrate prior to proceeding.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to material Manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

1. Ensure that penetrating work by other trades is in place and complete.
2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the fluid-applied membrane.
3. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges or with a material chemically compatible with the primary air material.

B. Prime substrate for installation of sheet membrane transition strips as recommended by material Manufacturer and as follows:

1. Prime masonry, concrete substrates with conditioning primers.
2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
3. Prime wood, metal, and painted substrates with primer.
4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier at protrusions.

C. Prime substrate for installation of fluid-applied air barrier if recommended by material Manufacturer based on project conditions.

D. Protection from spray-applied materials as recommended by material Manufacturer and as follows:

1. Mask and cover adjacent areas to protect from over-spray.
2. Ensure any required foam stop or back up materials are in place to prevent over-spray and achieve complete seal.

3.3 INSTALLATION

A. Fluid Applied Membrane Air Barrier: Install air barrier accessories and fluid-applied membrane air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance with material Manufacturer's instructions and the following (unless Manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials):

1. Install veneer anchors as per air barrier Manufacturer installation sequencing.
2. Apply treatment to exterior gypsum joints and screw heads as per air barrier material Manufacturer.
3. Apply primer for transition material at the rate instructed by the air barrier material Manufacturer for 1 inch beyond terminating edge of transition membrane. Allow primer to set / cure completely before transition strip application.
4. Position subsequent sheets of transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Ensure transition membrane is securely sealed onto substrate with roller.
5. Overlap horizontally adjacent pieces of transition material a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Roll all areas of transition strip including seams with roller.
6. Seal around all penetrations with termination mastic / sealant, membrane counterflashing or other procedure in accordance with material Manufacturer’s instructions, ensuring chemical compatibility amongst adjoining materials.
7. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors, other intersection conditions and transitions from wet cavity to dry cavity and seal penetrations using accessory materials in accordance with the material Manufacturer’s instructions.
8. Provide transition material at changes in substrate plane (with bead of sealant / mastic, membrane counter-flashing or other material recommended by material Manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
9. Provide mechanically fastened non-corrosive metal sheet or other Manufacturer approved transition material to span gaps greater than 1 inch in substrate plane and to make a smooth transition from one plane to the other. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining 2 inch overlap on both edges.
10. Lap transition material over top edge of through-wall flashing and head-flashing.
11. Provide backup for the membrane to accommodate anticipated movement or use other Manufacturer approved transition material at deflection and control joints.
12. Provide transition material to joint assemblies at expansion and seismic joints.
13. Provide backup for the fluid applied air barrier to accommodate anticipated movement at deflection and control joints as recommended by material Manufacturer.

14. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and / or as otherwise recommended by the material Manufacturer.
15. Seal top edge of the self-adhered membrane to substrate with termination mastic at end of each working day.
16. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by material Manufacturer.
17. Install primer for fluid-applied air barrier if instructed by material Manufacturer.
18. Install fluid-applied membrane using equipment and methods recommended by Manufacturer to achieve a dry film thickness as required by the material Manufacturer.
19. Do not allow materials to come in contact with chemically incompatible materials.
20. Do not expose membrane to sunlight / ultraviolet light longer than as recommended by the Manufacturer.
21. Turn flashing membrane into window opening at sill, jambs and heads. Terminate just before interior sealant bead.

3.4 FIELD QUALITY CONTROL

A. Owner’s Inspection and Testing: Cooperate with Owner’s testing agency as applicable. Allow access to work areas and staging. Notify Owner’s testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.

B. Manufacturer’s Field Representative Review: Contractor is not to commence any work other than staging until contact and meeting with the Manufacturer’s Field Representative on site. The Manufacturer’s Field Representative is to visit the jobsite a minimum of four (4) times to review work processes and / or work completed prior to work commencement, at 10% completion, at 50% completion and prior to the work being covered by finish materials.

3.5 PROTECTING AND CLEANING

A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material Manufacturer's written instructions.

1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier Manufacturer.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by Manufacturer of affected construction and acceptable to the primary material Manufacturer.

END OF SECTION

SECTION 07 42 13 - METAL WALL PANELS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Concealed fastener metal wall panels as part of the assembly.
   2. Modular metal wall panel system consisting of aluminum panels in a rainscreen application.
   3. Accessories necessary for a complete installation.

B. Related Sections:
   1. Section 05 40 00 - Cold Formed Metal Framing.
   2. Section 07 21 00 - Thermal Insulation: Batt and board insulations under meatl wall panels.

1.3 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

C. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

E. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, licensed in the State in which the Project is located with experience in the design of metal composite wall panels as part of curtainwalls and aluminum storefront systems to design and coordinate the cladding assembly using performance requirements and design criteria indicated.

B. All Cold-Formed Metal Framing for Metal Wall and Soffit Panels to be designed by a Professional Engineer licensed in the State in which the Project is located per Section 05 40 00 - Cold Formed Metal Framing.

1.5 SYSTEM REQUIREMENTS

A. Modular Metal Panel System: Rainscreen design consisting of dry seal joinery designed, attachment system components, and associated necessary to minimize water penetration and induce air circulation in the space behind the panel system. Moisture weeping trim at panel base details allows water to drain out of the system.

1.6 SUBMITTALS

A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings: Provide shop drawings prepared by manufacturer or manufacturer’s authorized dealer. Include full elevations showing openings and penetrations. Include details of each condition of installation and attachment. Provide details at a minimum scale 3-inches per foot of all required trim and extrusions needed for a complete installation.
   1. Include data indicating compliance with performance requirements.
   2. Indicate points of supporting structure that must coordinate with modular metal panel system installation.

C. Samples:
   1. One foott long sample of each listed panel, including clips (if applicable) & fasteners. Indicate perforation pattern where applicable.
   2. Minimum 2 by 4 inch (51 by 102 mm) chip of specified finish.

D. Qualification Information: For Installer and Installer's field supervisor.

E. Warranty: Manufacturer's sample warranty as specified.

1.7 DELIVERY AND STORAGE

A. All panels shall be delivered with appropriate packaging to provide protection against transportation damage. Materials damaged in shipping or storage shall not be used.

B. Store all materials and accessories above ground on well-skidded platforms. Store under waterproof covering. Provide proper ventilation to panels to prevent condensation build-up between panels.

1.8 COORDINATION

A. Coordinate work with installation of associated metal flashings and manufactured roof panels.

B. General contractor shall coordinate with all subcontractors including masonry, waterproofing membrane, sheathing work, and framing to ensure walls are plumb and ready to accept fasteners and panel systems.

C. Pre-construction meeting required with the Owner and the Architect. Representatives from all associated trades shall attend to coordinate arrival, delivery, and installation of products and materials.

1.9 WARRANTY

A. Warrant the work specified herein for five years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials or workmanship.

B. Provide a manufacturer's thirty year finish integrity warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Uninsulated Metal Wall Panels:
      a. Berridge Manufacturing Company: www.berridge.com.
      b. CENTRIA, a Nucor company: www.centria.com.
      c. Fabral: www.fabral.com/systems/commercial.
      d. Imetco.
      e. Metl-Span, an Nucor company: www.metlspan.com.
      f. PAC-CLAD, a Carlisle Construction Materials brand: www.pac-clad.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum: AWS D1.2/D1.2M.

b. Sheet Steel: AWS D1.3/D1.3M.
c. Stainless Steel: AWS D1.6/D1.6M.
d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS

A. Uninsulated Metal Panels:
1. Concealed-Fastener Metal Wall Panels (MPU-1):
a. Basis of Design: FW-12 Panel as manufactured by Berridge Manufacturing Company.
b. Panel Coverage: 12 inches,
c. Panel Height: 7/8 inch (22 mm).
d. Finish: Two-Coat Fluropolymer: 0.2 mil (0.005 mm) primer with a 0.8 mil (0.020 mm) 70 percent PVDF fluoropolymer color coat containing metal flakes, and a 0.5 mil (0.013 mm) 70 percent PVDF fluoropolymer clear coat, AAMA 2605.
e. Color: Dark Bronze.
2. Concealed-Fastener Metal Wall Panels (MPU-2):
a. Basis of Design: FW-12 Panel as manufactured by Berridge Manufacturing Company.
b. Panel Coverage: 12 inches,
c. Panel Height: 7/8 inch (22 mm).
d. Finish: Two-Coat Fluropolymer: 0.2 mil (0.005 mm) primer with a 0.8 mil (0.020 mm) 70 percent PVDF fluoropolymer color coat containing metal flakes, and a 0.5 mil (0.013 mm) 70 percent PVDF fluoropolymer clear coat, AAMA 2605.
e. Color: Shasta White.
3. Concealed-Soffit Panel (SFT-1):
a. Basis of Design: Thin Line as manufactured by Berridge Manufacturing Company.
b. Finished: Pre-Finished per Architects Selections.

B. Accessories:
1. Zees: 16 gauge minimum thickness galvanized steel, 2 inch rise minimum, or as required to align with existing conditions.
2. Sub-Girt Fasteners: Stainless Steel screws to meet application.
3. Concealed Fasteners: Stainless Steel screws supplied or recommended by panel manufacturer to suit application.
4. Metal Trim at Siding Panels: 0.060 inch thick pre-finished aluminum sheet, matching finish type and color of siding panels.
5. Closures: 0.060 inch thick aluminum sheet, mill finish.
6. Separate dissimilar metals with asphalt-saturated building felt or a bituminous coating to prevent galvanic action.

PART 3 EXECUTION

3.1 EXAMINATION OF MODULAR METAL PANEL SYSTEM

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
a. Verify that air or water resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel as required by manufacturer's written recommendations.

3.3 METAL WALL AND SOFFIT PANEL INSTALLATION

A. Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the work securely in place, with provisions for thermal and structural movement.
   1. Shim or otherwise plumb substrates receiving metal composite material panels.
   2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self tapping screws. Do not begin installation until air or water resistive barriers and flashings that will be concealed by metal composite material panels are installed.
   3. Install screw fasteners in predrilled holes.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.
   5. Install flashing and trim as metal composite material panel work proceeds.
   6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self tapping screws. Fasten flashings and trim around openings and similar elements with self tapping screws.
   8. Provide weathertight escutcheons for pipe and conduit penetrating panels.

B. Fasteners:
   1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.

D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
   1. Include attachment to supports, panel to panel joinery, panel to dissimilar material joinery, and panel system joint seals.

E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
   1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 07 92 00.
   2. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.
   3. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.

F. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed and returned flanges of wall panels to panel clips with standard fasteners.
   1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 07 92 00 “Joint Sealants”.
   2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.

G. Subgirt and Spline Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard subgirts and splines that provide support and complete secondary drainage assembly, draining to the exterior at horizontal joints. Attach metal composite material wall panels by interlocking perimeter extrusions attached to panels with subgirts and splines. Fully engage integral subgirt and spline gaskets and leave horizontal and vertical joints with open reveal. Terminate edge of panels flush with perimeter extrusions.
   1. Install wall panels to allow individual panels to free float and be installed and removed without disturbing adjacent panels.
   2. Do not apply sealants to joints unless otherwise indicated.

H. Track Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard horizontal tracks and vertical tracks that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach metal composite material wall panels to tracks by interlocking panel edges with manufacturer's standard "T" clips.
   1. Attach routed and returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
   2. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
   3. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
   4. Do not apply sealants to joints unless otherwise indicated.

I. Rainscreen Principle Installation: Install using assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
   1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
   2. Do not apply sealants to joints unless otherwise indicated.

J. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; provide types recommended in writing by metal composite material panel manufacturer.

K. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA Architectural Sheet Metal Manual. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
   1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and location lines as indicated, and within 1/8 inch (3 mm) offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.

B. Water Spray Test: After installation, test area of assembly directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer Field Service: Engage a factory authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.

D. Metal composite material wall panels are considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13

SECTION 07 42 13.16 - METAL PLATE WALL PANELS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Metal plate panels for walls and soffits, with related flashings and accessory components.
      a. Pressure equalized rain screen (PERS) based system.

B. Related Sections
   1. Section 07 21 00 - Thermal Insulation.
   2. Section 07 27 26 - Fluid-Applied Air Barrier System: Water-resistive barrier (WRB) behind wall panels.
   3. Section 07 92 00 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.3 REFERENCE STANDARDS

A. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

B. AAMA 508 - Voluntary Test Method and Specification for Pressure Equalized Rainscreen Wall Cladding Systems; 2021.

C. AAMA 509 - Voluntary Test and Classification Method for Drained and Back Ventilated Rainscreen Wall Cladding Systems; 2022.

D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

E. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

I. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

J. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate panel installation with adjoining work such as water-resistive barrier (WRB), water drainage, flashing, trim, stud back-up, and soffits.

B. Preinstallation Meeting: Convene one week before starting work related to installation of wall panel substrate.
   1. Require attendance of parties directly effecting work of this section, as follows:
      a. Architect.
      b. Contractor.

2. Review procedures for coordinated installation of wall assembly components by multiple installers and to maintain proper water-resistive barrier (WRB) and panel substrate performance requirements.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.

D. Samples: Submit two samples of wall panel and soffit panel, 6 inches by 6 inches in size illustrating finish color, sheen, and texture.

E. Test Reports: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Testing agency's qualification statement.

I. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in the Owner's name and registered with manufacturer.

J. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified with minimum three years of documented experience.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.7 MOCK-UPS

A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.

B. Construct mock-up, ____ feet (____ m) long by ____ feet (____ m) wide; include panel and soffit system, glazing, attachments to building frame, associated air/water barrier materials, weep drainage system, sealants and seals, and related wall insulation in mock-up.

C. Locate where directed.

D. Mock-up may remain as part of work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

C. Store prefinished material off ground and protected from weather; prevent twisting, bending, or abrasion, and provide ventilation to stored materials; slope metal sheets to ensure drainage.

D. Prevent contact with materials that may cause discoloration or staining of products.

1.9 FIELD CONDITIONS

A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.10 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

B. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in the Owner's name and register with warrantor.

C. Special Warranty: Provide 2-year warranty covering water tightness and integrity of seals of metal plate wall panels. Complete forms in the Owner's name and register with warrantor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Pre-Finished Aluminum Metal Plate:
      a. Alfrex, LLC: www.alfrexusa.com.
      b. Lumabuilt: www.lumabuilt.com.
      c. Astyl.
   2. Thermal Clips:
      a. Northern Facades: www.northernfacades.com.
   3. Aluminum Hat Channels:
      a. Eagle Mouldings, Inc: www.eagle-aluminum.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum:AWS D1.2/D1.2M AWS D1.2/D1.2M.
      b. Sheet Steel: AWS D1.3/D1.3M.
      c. Stainless Steel: AWS D1.6/D1.6M.
      d. Steel: AWS D1.1/D1.1M.

2.3 BASIS OF DESIGN

A. Pre-Finished Aluminum Metal Plate:
   1. Concealed Fastener Panals as manufactured by Astyl.
   2. Thickness: 1/8 inch.
   3. Perforations: Standard Laser Cut.
   4. Type: Concealed fastener on aluminum sub-framing at 4'-0" OC max.

2.4 PERFORMANCE REQUIREMENTS

A. Metal Plate Wall Panels System: Factory fabricated prefinished metal panel system, site assembled.
   1. Type of Wall Panel System: Pressure Equalized Rain Screen (PERS) in compliance with AAMA 508.
   2. Provide exterior wall panels, soffit panels, and subgirt framing assembly.

3. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
4. Design Pressure: In accordance with applicable codes.
5. Wind Load Testing: In compliance with ASTM E330/E330M to obtain the following results:
   a. Maximum Allowable Deflection of Non-Exposed Panels: L/60 for length(L) of span; no permanent deformation of panel system is allowed.
   b. Maximum Allowable Deflection of Highly Visible Panels: L/175 for length(L) of span or 3/4 inch (19 mm) whichever is less, normal to plane of wall between supports of secured perimeter framing members.
6. Fire Performance: Tested in accordance with, and complying with acceptance criteria of NFPA 285.
7. Intermediate Panel Stiffeners: Provide as required by design loads applied to panels, and secured to rear face of panel with silicone based adhesive and of size and strength to maintain panel flatness; stiffener material is compatible with silicone.
8. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to 100 degrees F (56 degrees C) seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
9. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
10. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
11. Corners: Factory-fabricated in one continuous piece with minimum 2 inch (51 mm) returns.
12. Provide continuity of air/water barrier (AWB) seal at wall panel substrate and/or wall sheathing in coordination with material requirements; refer to Section 07 27 26 - Fluid Applied Air Barrier System.

2.5 COMPONENTS

A. Metal Plate Wall Panels:
   1. Orientation: Vertical; style as indicated.
   2. Joint Layout: As indicated on Drawings.
   3. Material: Aluminum, 1/8 inch minimum thickness.
   4. Panel Width: As indicated on Drawings.

B. Metal Plate Soffit Panels:
   1. Joint Layout: Style as indicated for wall panels.
   2. Material: Aluminum, 0.125 inch (3.18 mm) minimum thickness.
   3. Panel Width: As indicated on Drawings.

C. Subgirts: C-shaped furring channel; to attach wall panel system to face of building structural wall.

D. Trim and Flashings: 22 gauge, 0.0299 inch (0.76 mm) thickness and finish as metal panels; brake formed to required profiles.

E. Fasteners: Fabricate using aluminum, cadmium plated steel, or stainless steel material.

2.6 MATERIALS

A. Aluminum Plate: ASTM B209/B209M, 3003 alloy, H14 temper.

B. Water-Resistive Barrier (WRB): Refer to Section 07 27 26 - Fluid Applied Air Barrier System.

C. Substrate Wall Sheathing: Refer to Section 06 16 00 - Sheathing.

D. Substrate Wall Insulation: Refer to Section 07 21 00 - Thermal Insulation.

2.7 FINISHES

A. Superior Performing Organic Top Coating: Comply with AAMA 2605 for testing, performance, and application procedures, and consisting of two-coat, thermally cured polyvinylidene fluoride (PVDF) system.
   1. Chemically etch metal panels using appropriate cleaner in accordance with manufacturer's written instructions.
   2. Primer: Apply acid resistant primer to cleaned aluminum metal plate; thickness range of 0.2 mil, 0.0002 inch (0.005 mm) to 0.3 mil, 0.0003 inch (0.008 mm).
   3. PVDF Resin Color Coating: At least 70 percent polyvinylidene fluoride (PVDF) based; thickness range of 0.8 mil, 0.0008 inch (0.02 mm) to 1.2 mil, 0.0012 inch (0.03 mm) and applied by metal finisher certified by coating manufacturer.
   4. Color: As selected by the Architect from manufacturer's standard line.

2.8 ACCESSORIES

A. Support for Cladding and Continuous Insulation: Thermal clips.
   1. Thermally-broken clips that provide attachment support for girts, angles, channels, and other cladding support framing.
   2. Clip Depth: As required for thickness of insulation.
   3. Spacing of Clips: 16 inches (406 mm) on center, vertically.
   4. Fasteners: As recommended by clip manufacturer.
   5. Basis of Design Product:
      a. ISO Clip manufactured by Northern Facades.

B. Support for Cladding and Continuous Insulation:
   1. Refer to Section 07 05 43 - Cladding Support Systems.

C. Aluminum Hat Channels: Fireproof extruded aluminum, corrosion resistant.
   1. Metal Thickness: As indicated on drawings, nominal.
   2. Width: As indicated on drawings, overall width.
   3. Height: As indicated on drawings, nominal.
   4. Basis of Design Product:
      a. Aluminum Hat Channels manufactured by Eagle Mouldings, Inc.

D. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.

E. Sealants: Comply with ASTM C920, refer to Section 07 92 00 - Joint Sealants for additional requirements.
   1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
   3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

F. Fasteners: Manufacturer's standard type to suit application; cadmium coated metal with soft neoprene washers.
   1. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws.

G. Field Touch-up Paint: As recommended by panel manufacturer.

H. Bituminous Paint: Asphalt based.

2.9 SOURCE QUALITY CONTROL

A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.

B. Testing of Pressure Equalized Rain Screen (PERS) Panel System: Submit results in compliance with AAMA 508 test methods for PERS metal plate wall panel system similar to system specified.

C. Testing of Drained and Back Ventilated (D/BV) Rain Screen Panel System: Submit results in compliance with AAMA 509 test methods for D/BV metal plate wall panel system similar to system specified.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrate framing members are ready to receive panels.

B. Verify water-resistive barrier (WRB) has been properly installed over substrate, refer to Section 07 27 26 - Fluid Applied Air Barrier for additional information.

3.2 PREPARATION

A. Install subgirts perpendicular to panel length, securely fastened to substrates, shimmed and leveled to uniform plane, and spaced at intervals indicated.

B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.3 INSTALLATION

A. Install panels on walls and soffits in accordance with manufacturer's instructions and approved shop drawings.

B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint; allow time to properly dry prior to wall panel installation.

C. Fasten panels to substrate structural supports; aligned, level, and plumb.

D. Locate joints over supports, and lap panel ends minimum 2 inches (51 mm).

E. Provide expansion and control joints where indicated.

F. Use concealed fasteners unless otherwise indicated and approved by the Architect.

G. Seal and place gaskets to prevent weather penetration; maintain neat appearance.

3.4 TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch (1.6 mm).

B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch (6.4 mm).

3.5 FIELD QUALITY CONTROL

A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.

B. Barrier Wall Water-Spray Test: Test assembled area as directed by the Architect for water penetration in accordance with AAMA 501.2.

C. Do not cover installed air/water barriers until required inspections have been completed.

D. Obtain approval of installation procedures by air/water barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.

E. Take digital photographs of each portion of installation prior to covering up.

3.6 CLEANING

A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements.

B. Remove site cuttings from finish surfaces.

C. Remove protective material from wall panel surfaces.

D. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

E. Upon completion of installation, thoroughly clean prefinished aluminum surfaces in accordance with AAMA 609 & 610.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 07 42 13.16

SECTION 07 54 19 - FULLY ADHERED TPO HYBRID MEMBRANE ROOFING SYSTEM

PART 1 - GENERAL

RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Providing the entire roofing assembly, including, but not limited to:
   1 Wood nailers (Refer to this Section and Section 06 10 00)
   2 Curbs (Refer to Section 07 72 00)
   3 Fully adhered thermoplastic single-ply membrane roofing
   4 Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 63 00)
   5 Walkway pads, expansion joints, and other work incidental to, the complete and proper installation of a watertight roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.

B. It is the intent of this Section that the Work shall:
   1. Provide a watertight facility.
   2. Conform to all applicable building code requirements and of authorities having jurisdiction.
   3. Include Section 07 63 00, and Section 07 72 00, as part of the Work of this Section; and be performed by a single source contractor.
   4. Coordinate with General Contractor of temporary equipment and conduit on roof and protection of installed roof membrane.

1.3 RELATED WORK

A. All Sections of Work relating to the roofing system, including mechanical, plumbing and electrical items penetrating the roof system.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. A 385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
   2. D 471, Resistance to water absorption
   3. D 751, Method of Testing Coated Fabrics
   4. D 1149 Ozone resistance
   5. D 1204 Linear Dimensional Change
   6. D 2137 Brittleness point, max,
   7. D 4637/6878(annex A1) Thickness over scrim
   8. E 96 Water vapor permeance, Perms
   9. E 903 Solar Reflectance (albedo X 100), %
   10. G 151/154 Accelerated weathering
   11. FTM 101C method 2031 Puncture resistance

B. ASCE-7 Wind uplifts requirements for geographical area.

C. Federal Specifications (FS)
   1. TT-S-00230C

D. National Roofing Contractors Association (NRCA)
   1. Roofing and Waterproofing Manual (Latest Edition)

E. Single Ply Roofing Institute (SPRI)

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
   1. Architectural Sheet Metal Manual (Latest Edition)

G. Underwriters' Laboratories (UL)
   1. Fire Hazard Classifications

H. International Building Code

1.5 PERFORMANCE REQUIREMENTS

A. General Requirements: Provide an installed thermoplastic single ply roofing system, flashing and related work that is watertight and will not permit the passage of liquid water, able to withstand wind loads, thermally induced movement and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. Roofing System Design: Comply with ANSI/SPRI "Wind Design Standard Practice for Roofing Assemblies" for the following ground roughness exposure and system design:
   1. Check for geographical exposure (i.e. Exposure B: City, suburban areas, towns and wooded terrain.)
   2. Fully Adhered thermoplastic single-ply membrane roofing.

D. Underwriter's Laboratories Inc. (UL)
   1. UL RMSD – Current Roofing Materials and Systems Directory
   2. UL Fire Resistance of Roofing Coverings Materials
   3. Exterior Fire Exposure Classification: Class A, ASTM E 108, for application and slopes shown.

E. American Architectural Manufacturer's Association (AAMA)

F. Occupational Safety and Health Administration (OSHA)

G. International Building Code (IBC)

1.6 SUBMITTALS

A. Product Data: Manufacturer's printed instructions, tested assemblies, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, adhesive, and accessories to be used in the Work.

B. Certifications:

1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system. **(Submit a copy with Proposal Form)**
2. Manufacturer's affidavits that materials used in Project contain no asbestos.
3. Installer shall submit resume and project experience list for proposed system for Project Manager and job site superintendent.
4. Installer shall submit written certification that there are no undocumented workers being employed by them or any subcontractor on this project and that covers all workers on this project by workmen's compensation.
5. Installer shall submit list of all subcontractors with evidence of subcontractor's insurance coverage in compliance with contract requirements.
6. Manufacturer's written certification of approval / acceptance of these specifications and details.

C. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.

D. Shop Drawings: Furnish from copies of the Manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", (Latest Edition).

1. Furnish for approval any proposed details, which differ from those, included with this proposal package. All proposed details shall first be approved in writing by roofing manufacturers prior to submitting to Architect for approval.
2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.

E. Samples:

1. Furnish copy of sample warranty that is to be issued upon project completion.
2. Furnish samples of roof membrane.
3. Furnish sample of metal edge to be installed.

F. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:

1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
2. Contractor's Warranty: Contractor's written warranty as specified.
3. Maintenance Procedures: Three (3) copies of Manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.
4. Affidavits of non-asbestos for material.
5. Affidavits from material manufacturers, suppliers and sub-contractors for release of liens.
6. Refer to Section 01 78 39 for additional requirements of close-out documents.

1.7 INSPECTIONS / TESTS

A. The Architect's and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.

1 Architect Observations: The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.

2 Manufacturer Inspections:

a. An inspection shall be made by a representative of the material manufacturer **three (3) times per month** during performance of Work to ensure that said project is installed in accordance with the Manufacturer's specifications and illustrated details. Written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.

b. The authorized material Manufacturer's field representative shall be responsible for:

1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.
2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.
3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.
4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications.

B. Any failure by the Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.

C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.

1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
2. Re-tests for work which fail initial tests or inspections shall be paid by contractor.
3. **Non compliance with contractor requirements will result in the Architect / Owner to assign full time quality control and will be subject to reimbursement by the construction manager/contractor**.

1.8 QUALITY ASSURANCE

A. Installer:
   1. Installer shall have approval by manufacturer of accepted roofing system for application and issuance of specified warranty for a minimum of three (3) years. Proof of license agreement dated at least three years prior to date of bid opening.
   2. Installer shall be an experienced single firm specializing in the type of roofing and sheet metal work specified, with a minimum of five (5) years of previous successful experience on projects similar in size and scope.
   3. Installer shall be certified and approved by manufacturer and licensed to install specified roofing system.
   4. No subcontracting of sheet metal fabrication or installation will be accepted. Installer must have a sheet metal shop on the company premises.
   5. Installers shall have a competent Superintendent, who is not actually performing roofing work, on site at all time while work is in progress, with full authority to act on behalf of the Installer as his agent.
   6. All workmen shall be covered by Workmen's Compensation insurance (verify upon request) and thoroughly experienced in the particular class of work upon which employed. Use of undocumented workers will not be tolerated - No Exceptions.
   7. Installer shall ensure that base fastener pull out resistance tests on existing decks were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.
   8. Roofing installer must have reached the highest level of qualifications from the Manufacturer they are providing material for (i.e. Master Select installer).

B. Regulatory Requirements:
   1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
   2. Roofing system shall be installed in accordance with ASCE-7-16 wind uplift requirements for geographical location exposure C, 147 MPH 3-second gust wind speed zone and risk category III based on IBC building code requirements. Wind-resistance loads listed below have a safety factor of 2.0 incorporated into the calculation.
      a. Zone 1' Field 51.5 psf or as otherwise indicated by Structural
      b. Zone 1 Field 89.7 psf or as otherwise indicated by Structural
      c. Zone 2 Perimeter 118.3 psf or as otherwise indicated by Structural
      d. Zone 3 Corner 161.3 psf or as otherwise indicated by Structural
   3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.

C. Laboratory Testing and Samples:
   1. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.
   2. Owner will select testing laboratory and will pay for Work required by testing laboratory. Installer shall assume all costs for extraction and patch of all samples.
   3. Re-tests for work which fail initial tests or installer shall pay inspections.
   4. Installer shall correct all deficiencies in accordance with manufacturers recommended procedures at no cost to Owner.

D. Installation:
   1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
   2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Installer's Association.
   3. It will be the installer's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the installer shall be responsible for the correctness of it. Any drawings supplied are for reference only.
   4. Installer shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
   5. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. All workmen shall be thoroughly experienced in the particular class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
   6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust, and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean and all installers' equipment and materials removed from the site.

1.9 PERFORMANCE REQUIREMENTS

A. Fire Resistance: Meet Underwriter's Laboratory Class "A" fire rating

B. Installer shall ensure that base fastener pull-out resistance tests on new lightweight insulating concrete fill were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.

1.10 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination.

1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in Manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels, shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. The proper storage of materials is the sole responsibility of the contractor. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site,

and replaced with new materials prior to application.

B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be accepted minimum for exterior coverings. All materials stored, as above shall be minimum of four (4) inches off the substrate, and the tarpaulin tied off with rope.

C. Products liable to degrade as a result of being frozen shall be maintained above 40º F in heated storage.

D. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

E. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not in use.

1.11 WARRANTY

A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:
1. The warranty shall be a NDL “No Dollar Limit” / no penal sum type, with total replacement cost.
2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
3. The roof system including roofing insulation, flashing, penetrations, wall flashings, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
4. Submit four (4) original executed copies of the Warranty / Guarantee.

B. Roofing Installer: Jointly with any sub installers employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Installer, and sub installers, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.

C. Make arrangements with the materials manufacturer to provide the required warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

D. Submit attached Installer’s Warranty and Sub installer’s Guarantee forms at Project Closeout.

PART 2 - PRODUCTS

2.1 GENERAL

A. The components of the roof system are intended to be products of a single manufacturer as required providing the specified system warranty. Products not manufactured by the Roofing Manufacturer, but are required in the roofing assembly, will be recognized by the Roofing Manufacturer and covered under the Manufacturer’s warranty.

B. Install all materials in accordance with Manufacturer's current written specifications, details and instructions. Deviations shall not be made without prior written approval from the Manufacturer and the Owner's Representative. Should any specifications or details conflict with the Contract Documents, submit to Owner the recommended alternative that provides the best long term moisture protection and complies with Manufacturer's warranty requirements for approval.

C. Bitumen kettles or tankers shall have a visible thermometer and thermostatic control to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions. All kettles shall be equipped with afterburners to minimize fumes. Circulate bituminous materials, do not allow bituminous materials to stand in luggers for long periods. Use insulated hot transport lines and luggers. Kettle shall be kept a minimum of 20 feet away from building, placed so that fumes, odors, and smoke, do not enter building through windows, doors, fresh air vents or similar entrances; are not directed towards freshly painted or anodized surfaces, glass or other glazing materials. Do not place kettle under trees or near vegetation. The assigned kettle man shall remain in close attendance, within 25 feet of ground level, while burners are lit. Kettle lids are to remain closed except for loading. Level of bitumen shall be kept within eight (8) inches from top of kettle.
   1. Asphalt Bitumen Heating: Heat and apply bitumen in accordance with equiviscous temperature method ("EVT Method") as recommended by the manufacturer. Discard bitumen that has been held at temperature, exceeding finished blowing temperature (FBT) for a period exceeding three hours. Do NOT heat bitumen to a temperature higher than 25 degrees F (14 degrees C) below flash point.
   2. Asphalt Temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525 degrees F. Minimum application temperature shall be 400 degrees F.
   3. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 pounds per square. Mopping shall be total in coverage, leaving no breaks or voids.

2.1 ROUGH CARPENTRY

A. All nailers, cants and wooden curbs shall be No. 2 or better treated lumber selected to meet design details and field dimensions and requirements of Section 06 10 00, Rough Carpentry. MCQ and MCA only.

2.2 ROOFING SHEET METAL

A. Refer to Section 07 63 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.

2.3 APPROVED MANUFACTURERS

A. Specifications are based on "Ultraply TPO XR" Elevate, fleece-backed, fully adhered TPO roofing system manufactured by Elevate Building Products. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions.
   1. GAF Everguard
   2. Johns Manville

B. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an applicator licensed by the manufacturer.

C. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
D. All materials used on the project shall be asbestos free.

2.2 ROOF MEMBRANE ASSEMBLY / FLASHING MEMBRANE AND FINISH PLY DESCRIPTION

A. System Description: A roof membrane assembly consisting of one (1) ply of fleeced backed uniformed, flexible sheet formed from thermoplastic polyofin membrane secured to a one (1) ply of prefabricated, reinforced, homogeneous polymer modified asphalt membrane, secured to specified insulation or substrate. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system. Installer option to install using hot asphalt “mopped”, cold adhesive, torched, or any combination – confirm special membrane types with manufacturer. Provide components of the roof membrane assembly meeting the following physical and mechanical requirements.

B. TPO Sheet: Uniform, flexible sheet formed from thermoplastic polyolefin, of the following type, thickness, and exposed face color:
1. Polyester-reinforced TPO
2. Fabric Reinforced, Total Thickness – 115 mils
3. TPO Polymer Thickness: 60 mils
4. ASCE-7 Wind uplift requirements
5. UL Class A.
6. Exposed Face Color: White

C. Physical Properties:

Property	Value	Test Method
Min. polymer thickness, inch	0.060 0.072 0.080	ASTM D 751
Elongation at break, MD	25%	ASTM D 751
Seam Strength, min. lbf of tensile or breaking strength	40	ASTM D 751
Elongation at break of fabric	25%	ASTM D 751
Tear Strength (lbf)	120	ASTM D 751
Brittleness Point	-40	ASTM D 2136
Accelerated Weathering Test (Xenon) - 10, 000 hours	Pass	ASTM G 26/151/154
Resistance to water absorption	+/-3%	ASTM D 471
Resistance to microbial surface growth(1 Very Poor, 10 no growth)	9-10	ASTM D 3274

3-Year SRI, 64 minimum.

2.3 ROOF MEMBRANE ASSEMBLY / UNDERLAYMENT DESCRIPTION

A. Base Sheet: Shall be a heavy duty (plus) base sheet or venting base as approved by proposed manufacturer. At lightweight concrete only.

B. Roofing Inter-ply Modified Bitumen Base Ply: A high performance modified bitumen base ply consisting of a reinforcing mat impregnated and coated with high quality modified bitumen: (Coordinate with manufacturer for special membrane type requirements when installed over insulation.)
   1. Elevate Product: SBS Base
   2. GAF: Ruberroid 20 Smooth
   3. Johns Manville: DynaBase

C. Dry Sheathing Paper: (For use as a slip sheet) Rosin coated 5 lbs per 100 SF.

2.4 ROOFING ACCESSORIES

A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing materials.
   1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdictions.

B. Flashing and Flashing Accessories: As recommended by the Thermoplastic sheet manufacturer's printed instructions for reinforced sheet flashing of same material, type, thickness, and color as sheet membrane.

C. Reroof Fasteners: FM Approved corrosion resistant steel screws of the appropriate size for fasteners for roof membrane and insulation attachment and for sheet metal flashing. Fasteners for the membrane shall be supplied by the thermoplastic manufacturer and are to be installed as recommended by Thermoplastic sheet manufacturer's printed instructions.

   1. Shall be Factory Mutual approved and supplied by the manufacturer for the specific application.
   2. Fastener for Brick: Zamac Nailin. Shall be 1/4 inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Power Fasteners, or approved equal.
   3. Nails: G-90 galvanized or non-ferrous type, size as required to suite application, minimum 11 gauge with 3/8 inch diameter head.
   4. Dual Prong Fastener: Coated Steel tube with stainless steel Locking Staple.

D. Lightweight Insulating Concrete Base Sheet Fasteners: Shall be approved by the fastener manufacturer, membrane manufacturer and FM for use with lightweight insulating concrete as follows:

      1. Fastener shall be a single unit, precision formed, of electro zinc coated steel 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 insulating concrete. Fasteners for lightweight insulating concrete shall meet FM Standard 4470 requirements for corrosion resistance. As manufactured by Olympic Fasteners, or approved equal.

E. Options for Modified Membrane
      1. Mopping Asphalt: Asphalt that has been certified for full compliance with the requirements for Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.

- Approved Product: Trumbull asphalt or as required by membrane.

1. Torching as recommended by Roofing manufacturer
2. Bonding Adhesive As recommended by Roofing manufacturer

F. Options for Thermoplastic Membrane

1. Mopping Asphalt: Asphalt that has been certified for full compliance with the requirements for Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.

- Approved Product: Trumbull asphalt or as required by membrane. (Ensure Manufacturers product will not allow bleed through

3. Lowrise foam as recommended by Roofing manufacturer
4. Bonding Adhesive As recommended by Roofing manufacturer

G. Bonding Adhesive: As recommended by thermoplastic sheet manufacturer's printed instructions to develop a bond between the membrane and the substrate to which the membrane is to be attached. Ultraply Bonding Adhesive or approved equal.

H. Metal Flashings, Copings, Edge Trim and Accessories: Provide all roofing manufacturer’s metal required for a complete roofing system covered under the manufacturer’s warranty.

I. Sealants: Membrane manufacturer’s approved sealant shall be used to seal penetrations through the membrane system and at miscellaneous sealant applications that come in contact with roof systems components.

J. Liquid Applied Flashings: Two-component polymethyl methacrylate-based (PMMA) material by Roofing Manufacturer. Include in 20 Year NDL warranty.

K. Miscellaneous Accessories: Provide pourable sealants, performed cone and vent sheet flashings, pre-formed inside and outside corner sheet flashings, T-joint covers, termination reglets, and other accessories as recommended by roofing system manufacturer for intended use.

L. Other miscellaneous materials shall be of the best grade available and approved in writing by roof system manufacturer, prior to use, for the specific application.

2.9 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Other materials shall be as shown, specified or required and be of the best grade for the proposed use as recommended by the manufacturer.

1. Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
2. Sealant Backer Rod: Provide compressible rod stack 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.
3. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc. Refer to

Section 07 72 00, Roof Accessories.

4. Cant Strips: Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.
5. Termination Bar:
   a. Material: Extruded aluminum bar with lip profile.
   b. Size: 0.090 inch thick by 3/4 inch wide with 3/16 inch lip width and a 45 degree lip angle, factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
   c. Approved Product/Manufacturer: “LIPTB 06” manufactured by Olympic Manufacturing Group, Inc., or approved equal.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

A. Existing Conditions: Examine existing building and new construction to determine existing physical conditions that affect installation of new roofing.

B. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to Manufacturer’s written instructions and warranty requirements.

C. Environmental Requirements:
1. Apply roofing in dry weather.
2. Do not expose roof components and flashing in inclement weather or when it is predicted 30% or more possibility for inclement weather.
3. When ambient temperature is below 40 degrees Fahrenheit, expose only enough sensitive cements, sealants, and adhesives as required for use within a four-hour period.
4. Do not expose membrane and accessories to a constant temperature of 180 degrees Fahrenheit.

D. Protection:
1. Provide special protection and avoid traffic on completed areas of membrane installation.
2. Restore to original condition or replace work or materials damaged during handling of roof materials.
3. Take precautions as required to protect adjacent work and structures.

E. Emergency Equipment: Maintain on site equipment necessary to apply emergency temporary edge seal in event of sudden storms or inclement weather.

F. Restrictions:
1. Comply with General Requirements on use of site.
2. Smoking is prohibited on all roof areas or in existing buildings.
3. Maintain facility and all utility services in a functional condition.
4. Provide sanitary facilities for employees.

3.2 EXAMINATION

A. Examine and verify that receiving substrate surfaces of the structure have no defects or errors, which would result in poor or potentially defective application or cause latent defects in workmanship.

1. Examine substrate to which roofing material is to be applied to ensure that its condition is satisfactory for roofing application. Do not permit voids greater than 1/4 inch wide in the substrate. Substrates for roofing materials shall be dry and free of oil, dirt, grease, sharp edges, and debris. Inspect substrates, and correct defects before application of thermoplastic sheets.

B. Verify that roofing openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.

C. Do not proceed with installation until unsatisfactory conditions have been corrected. Starting installation shall imply acceptance of surfaces and conditions.

3.3 NAILERS

A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building.

B. All Construction: Nailers shall be the same height as the new lightweight insulating concrete deck or insulation being installed or to existing raised roof edge whichever is applicable. Nailers shall be anchored to resist a pullout force of 300 pounds per linear foot per Factory Mutual Data Sheet 1-49. Fasteners shall be no less than two (2) per nailer, and be spaced at two (2) feet on center maximum. Provide nailers at all penetrations. Raise all curbs, flashing, etc, a minimum of eight (8) inches above the deck.

3.4 SUBSTRATE PREPARATION

A. Substrate Surface: Prepare substrate surfaces to insure proper and adequate installation, in strict accordance with the Contract Documents and approved Shop Drawings, or manufacturer's requirements.

B. Fill all gaps and voids between substrate components that are wider than 1/4 inch. Fill all gaps with same materials as the substrate.

C. The membrane manufacturer shall specify types of substrates that are suitable for use with the bonding adhesive.

D. Protection of Adjacent Areas or Surfaces: Protect adjacent areas or surfaces from damage as a result of the Work of this section. Remove sharp projections.

E. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

F. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.5 APPLICATION OF BASE SHEET

A. Base sheet: Lightweight Concrete shall be covered with a base sheet, mechanically fastened as follows:

1. Install in accordance with manufacturer's current published application instructions and to meet FM requirements for wind uplift requirements. Fasteners and fastening patterns shall be determined by building height, deck pull out values, location and geographical area of the United States. It is the contractor's

responsibility to consult current FM publications, literature, and bulletins that are in effect at the time of this project. Submit perimeter, field and corner fastening patterns and cite all FM data pertaining to the fastening pattern to the Architect for review.

3.6 INSTALLATION OF BASE PLY

A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow application of insulation as a continuous operation.

B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials and exercise care in ensuring that the finished application will be acceptable to the Owner.

C. Adhesive Application: Apply cold adhesive with a spray equipment or squeegee or as otherwise directed by the manufacturer in a smooth even, continuous layer without breaks or voids at the rate of 1 ½ to 2 gallons per square per ply. (The porosity of some substrates may require a heavier application to ensure full adhesion. Refer to manufacturer's requirements).

D. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.

E. All fishmouths shall be repaired daily. Fishmouths may not be "walked-in". Fishmouths shall be cut out and replaced by the same number of plies affected. No exceptions.

F. After completion of work, surface shall be checked for "fishmouths" or other objects causing separation between the reinforcing plies. Discrepancies shall be repaired to the Architect's acceptance. Areas indicating voids shall be cored, tested, repaired to manufacturer's acceptance. Aggregate surfacing may begin after test cuts or membrane is accepted by manufacturer and Architect. Provide copy of results from manufacturer to the Architect. This document is one of the prerequisites needed for surfacing to begin.

3.7 INSTALLATION OF THERMOPLASTIC MEMBRANE

A. General: Install in strict accordance with manufacturer's latest published requirements, instructions, specifications, and details and approved shop drawings.

B. Over the properly installed and prepared substrate, manufacturer's approved adhesive to be poured out of the pail and spread using notched ¼" X ¼" X ¼" rubber squeegees. The adhesive shall be applied at a rate according to manufacture requirements. No adhesive is applied to the back of the feltback membrane. ***Do not allow adhesive to skin over or surface-dry prior to installation of fleece-back membrane.***

C. The Fleeceback roof membrane is unrolled immediately into the wet adhesive. Adjacent rolls overlap previous rolls by 3 inches. This process is repeated throughout the roof area. Immediately after application into the adhesive, each roll shall be firmly pressed into place with a water filled, foam covered lawn roller by frequent rolling in two directions. ***Do not allow adhesive to skin over or surface dry prior to installation of fleece-back membrane.***

D. Weld cover strips at all seams that do not have a factory selvage edge.

E. For application of hot asphalt as an adhesive for the membrane, refer to manufacturer's recommendations.

3.8 SEAM INSTALLATION

A. Clean seam areas, overlap sheets, and weld side and end laps of sheets and flashings according to manufacturer's written instructions to ensure a watertight seam installation. Weld seam as follows:
1. Weld Method: Hot Air

B. Test lap edges with probe to verify seam weld continuity on a daily basis.

C. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

3.9 FLASHING INSTALLATION

A. Install sheet flashings and performed flashing accessories and adhere to substrate according to roofing system manufacturer's written instructions.

B. ¾" plywood is to be used at all parapets that receive wall flashings.

C. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

D. Flash penetrations and field-formed inside and outside corners with sheet flashing as recommended by manufacturer.

E. Clean seam areas, overlap seams, and firmly roll flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

F. Test lap edges with probe to verify seam weld continuity. Apply lap sealant, if required by roofing manufacturer, and seal exposed edges of sheet flashing terminations per manufacturer's requirements.

G. Terminate and seal top sheet flashings and mechanically anchor to substrate through termination bars.

3.10 METAL FLASHINGS, COPINGS, EDGE TRIM AND ACCESSORIES INSTALLATION

A. General: Secure metal flashings accessories at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.

3.11 OVERNIGHT SEAL / WATER CUT-OFF

A. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.

B. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

3.12 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

A. The following is a list of descriptions for correct installation of components integrated into the roof membrane assembly. In all cases, unless otherwise approved, incorporate flanged

components into the system between the application of the base ply and finish ply. The flange must be primed with a uniform coating of approved ASTM D41 asphalt primer and allowed to dry thoroughly; all flanges must be set in approved mastic.

B. Sealant: Caulk all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of approved sealant.

C. Sheet Metal: Refer to Section 07 62 00, ROOF RELATED SHEET METAL.

3.13 QUALITY CONTROL

A. Roofing Installer: On-site evaluation welded seams shall be made by the Contractor to locations as directed by the Owner's representative or TPO Manufacturer's technical representative. Two-inch wide cross-section samples shall be taken three times a day minimum through completed seams. Correct welds shall display failure from shearing of the membrane prior to separation of weld. The Contractor at no extra charge to the Owner shall patch each test cut. Test seam samples shall be label with location of seam cut, date of seam cut, and retain for Owner's representative or TPO Manufacturer's technical representative for test cut inspection.

B. Manufacturer's Quality Control Inspection: The Manufacturer's Technical Representative shall review the on-going work on a minimum of one time every 30 calendar days. All defects noted non-compliance with the Contract Documents or the recommendations of the Thermoplastic Manufacturer should be itemized in a punch list. These items must be corrected immediately by the Contractor to the satisfaction of the Owner's Representative and the thermoplastic manufacturer.

3.14 PROTECTING AND CLEANING

A. Protect sheet membrane roofing from damage and wear during remainder of construction period.

B. Immediately remove all spots, smears, stains, residues, adhesives, etc., from the Work of this Section and/or upon adjacent areas or surfaces, which result from the Work of this Section.

C. Upon completion of the Work of this Section, dispose of, away from the Site, all debris, trash, containers, residue, roofing remnants and scraps which results from the Work of this Section.

D. Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.

3.15 ACCEPTANCE

A. Prior to demobilization from the site, the Owner / Project Manager, Architect and Installer shall review the work. All defects noted noncompliance with the Contract Document or the recommendations of the TPO Manufacturer should be itemized in a punch list. These items must be corrected immediately by the Contractor prior to demobilization to the satisfaction of the Owner / Project Manager, and the TPO Manufacturer.

B. Notify Architect and Owner 48 hours in advance of the date and time of inspection.

C. All warranties as required for the project of this specification shall be submitted for

approval prior to final payment.

END OF SECTION

SECTION 07 62 00 - ROOF RELATED SHEET METAL

PART I – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. It is the intent of this Section that the Work shall:
   1. conform to all applicable building code requirements and of authorities having jurisdiction;
   2. include all shop and field formed sheet metal work shown on drawings, specified or required, including, but not limited to:
      a. Roof penetration sleeves and hood and umbrella counterflashing
      b. Metal counterflashing
      c. Expansion joint
      d. Roof drains
      e. Scuppers
      f. Metal perimeter edge
      g. Gutters, Downspouts, Splash Blocks and Splash Pans
      h. One-way roof moisture relief vents
      i. Metal gravity vents
      j. Metal heat exhaust vents
      k. Sanitary vent pipes
      l. Pipe box
      m. Copings, trim and miscellaneous sheet metal accessories.
   3. be part of the Work of the Roofing System; and
   4. be performed by a single source contractor.

1.3 RELATED WORK

A. Section 07 54 19 – Fully Adhered TPO Hybrid Membrane Roof System

B. Section 07 72 00 – Roof Accessories

C. All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing and electrical items.

1.4 REFERENCES

A. ASTM International (ASTM)
   1. A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   2. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
   3. B32, Standard Specification for Solder Metal
   4. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

B. ASCE 7

C. Federal Specifications (FS)
   1. QQ-L-201 for lead

D. National Association of Architectural Metal Manufacturers (NAAMM)

E. National Roofing Contractors Association (NRCA)
   1. Roofing and Waterproofing Manual

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
   1. Architectural Sheet Metal Manual

G. ANSI / SPRI ES-1

1.5 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer's installation instructions.

B. Shop Drawings: Indicating sizes, configurations, details of attachment to related and adjacent work, materials, and finishes.

C. Samples:
   1) Full range of finish colors for Architect's selection.
   2) 12 inch long sample of each specified item with approved finish.
   3) Provide full size mockup of all shop built assemblies.
   4) Documentation of Wind uplift requirements for Roof Edge for specific project location
      a. Wind Calculator available online

1.6 QUALITY ASSURANCE

A. Single Source Responsibility: Fabricator and installer of roof-related flashing, installer of prefabricated edge metal and accessories shall be the same as the membrane roof installer.

B. Comply with governing codes and regulations of authorities having jurisdiction.

C. ANSI / SPRI ES-1: Install sheet metal edge flashings and copings to comply with requirements of ANSI / SPRI ES-1 / FM 1-49 for minimum of up to 140 MPH wind speed zone and wind resistance loads.

1.7 INSTALLATION CONFERENCE

A. Refer to Section 01 31 13, Project Coordination.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, handle and store materials in accordance with manufacturer's instructions.

B. Handle and store materials and equipment in such a manner as to avoid damage.

C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.9 WARRANTIES

A. Manufacturer's Product Warranty:
   1) Manufacturer's standard 30 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) Wind Warranty
      a. Non Coastal: up to 160 MPH Blow Off Resistance, 20 Year
   4) Correction may include repair or replacement of failed product as outlined in Warranty Documents
   5) Finish warranty and wind warranty shall be delivered by Roofing Contractor to Owner at the conclusion of project as part of project closeout documents.

B. Roofing Contractor's Warranty:
   1. Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
   2. Defects shall include, but not be limited to:
      a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
      b. Leaking water or bitumen within building or construction.
      c. Becoming loose from substrate / blocking.
      d. Loose or missing parts.
      e. Finish failure as defined above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Metal Era, Inc., which is located at: 1600 Airport Rd.; Waukesha, WI 53188; Toll Free Tel: 800-558-2162; Tel: 262-549-6900; Fax: 800-373-9156; Email:request info (info@metalera.com); Web:www.metalera.com

B. Substitutions: Before proposal date upon roof consultant approval.

C. Requests for substitutions will be considered in accordance with provisions of Section 012513.

D. Manufacturers named within specification are approved for use on the Project providing:
   1. their products meet or exceed the specifications;
   2. company has a minimum of five (5) years' experience manufacturing products of the type specified;
   3. products have been tested in conjunction with roofing membrane system as an assembly and as such has obtained the same approval and rating as the roofing membrane system; and
   4. products are approved for use by the roofing membrane manufacturer.

2.2 SHEET METAL MATERIALS

A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing membrane system as an assembly and have the same approval and rating as the roofing membrane system.

B. Prefinished Aluminum Sheet:
   1. Precoated type, aluminum conforming to Fed. Spec. QQ-A-250, ASTM B209.
   2. Thickness: Minimum 0.040 inch, except as otherwise indicated. SMACNA recommendations shall govern.
   3. Finish: Kynar 500, color as selected by Architect from manufacturer's full range of standard and premium.

C. Prefinished Galvanized Sheet Steel:
   1. Commercial quality ASTM A527 G-90 hot-dip galvanized coating designation.
   2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
   3. Finish: Kynar 500 or Hylar 5000 in color as selected by Architect from manufacturer's full range of standard and premium colors.

D. Sheet Lead:
   1. Comply with FS QQ-L-201, Grade B
      a. Four (4) pound minimum for use at roof drains

E. Stainless Steel: ASTM A167, Type 302 / 304 Soft Temper, No. 2D finish. Minimum thickness 24 gauge, except as otherwise noted.

2.3 FASTENERS

A. Same metal as flashing / sheet metal or other non-corrosive metal or as noted below.

B. Exposed fasteners shall be self-sealing and gasketed (ZAC type) for weathertight installation.

C. Match finish of exposed heads with material being fastened.

D. Mechanical Fasteners:
   1. Nails: Ring shank, minimum 1-1/2 inches in length with 1/2 inch diameter head.
   2. Washers: Steel washers with bonded rubber sealing gasket.
   3. Screws: Self-tapping sheet metal type of stainless steel or compatible with material being fastened, with hooded integral EPDM washers (ZAC type).
   4. Rivets: Stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.

E. Clips:
   1. Cleat (coping / fascia): Minimum 22 gauge or .050 aluminum, G-90 galvanized, stainless steel, or aluminum. Match material of coping / fascia and provide one (1) gauge heavier.

2.4 RELATED MATERIALS

A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead.

B. Flux:
   1. Phosphoric acid type, manufacturer’s standard.
      a. For Use with Steel or Copper: Rosin flux
      b. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.

C. Underlayment:

1. At expansion joints: to be used as bellow; 48 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting manufactured by Nervastral, Inc. or Lexsuco.
2. At wood blockings: Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer and coordinate with specification 07 65 00.

D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and watertightness.

E. Metal Accessories: Sheet metal clips, straps, anchoring devices, clamps and similar accessories required for the complete installation of work, matching or compatible with material being installed, non-corrosive, size and gauge recommended by installer to suit application and performance.

F. Sealant:
1. Type A:
   a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
   b. Approved Products / Manufacturers: “Chem-Calk 900” manufactured by Bostik Construction Products Division, “Vulkem 921” manufactured by Mameco International, Inc., “Dynatrol I” manufactured by Pecora Corporation, “MasterSeal NP 1” manufactured by BASF, or approved equal.
2. Type B:
   a. Type: One-part, neutral-curing, medium-modulus silicone sealant for sealing metal to metal surfaces, i.e. metal edge, cover plates, etc.
   b. Approved Products / Manufacturers: “Chem-Calk 1200” manufactured by Bostik Construction Products Division, ”795 Silicone Building Sealant” manufactured by Dow Corning Corporation, “895 Silicone” manufactured by Pecora Corporation, “Omniseal” manufactured by Sonneborn Building Products, “Spectrem 2” manufactured by Tremco Incorporated, or approved equal.

G. Grout - Pitch Pans:
1. Type: Quick-setting, non-shrink, non-metallic, high strength formula complying with ASTM C1107.
2. Approved Products / Manufacturers: “Sure Grip High Performance Grout” manufactured by Dayton Superior Corporation, “Premier Quick-Trim” manufactured by L & M Construction Chemicals, Inc., “MasterFlow” manufactured by BASF, or approved equal.

H. Pitch Pan Filler:
1. Type: Pourable polyurethane sealer, approved by roofing system manufacturer.
2. Approved Products / Manufacturers: “Quick Pitch Sealer” manufactured by U.S. Intec, “SPM Pourable Sealer” manufactured by Johns Manville, or approved equal.

I. Termination Bar:
1. Material: Stainless steel or extruded aluminum bar with lipped profile.
2. Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
3. Approved Product / Manufacturer: “TB 125” manufactured by TruFast Corp., or approved equal.

J. Pipe Hangers and Supports: Refer to Section 07 72 00, Roof Accessories.

K. Splash Blocks: Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment. Use at locations where roof drainage discharges on ground.

L. Splash Pans: 22 gauge stainless steel, of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level(s).

2.5 FABRICATION

A. Except as otherwise indicated, fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and reviewed shop drawings. Form all flashings, receivers and counterflashings in accordance with standards set forth in the NRCA roofing manual and SMACNA.

B. Comply with manufacturer's installation instructions and recommendations.

C. Shop fabricate Thru-wall, counterflashings, expansion joint metal and wind clips to greatest extent possible.

D. Fabricate items to size and dimensions as indicated on the drawings. Limit single-piece lengths to twelve (12) feet for prefabricated pieces and ten (10) feet for shop fabricated pieces.

E. Face of any fabricated vertical metal fascia or coping shall not exceed 8” without stiffener band or birds beak. If stiffener band or birds beak cannot be fabricate, contractor to use multiple pieces of metal to achieve overall distance without going over the 8” maximum per piece.

F. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work sufficient to permanently prevent leakage, damage or deterioration of the work.

G. Integrate flashing in a manner consistent with membrane waterproofing detailing. Form work to fit substrates.

H. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.

I. Fabricated items will have straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.

J. Fold back edges on concealed side of exposed edge to form hem.

K. Unless noted otherwise, lap joints minimum three (3) inch. Lap joints to have sealant installed as per details, to maintain watertight condition, inside and outside corners and elevation changes to be riveted and soldered.

L. Seams:
1. Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
2. Pre-finished Galvanized Steel: Seal pre-finished metal seams with rivets and silicone sealant.
3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.

M. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying any primers. Prime all metal in contact with bituminous material.

N. Backpaint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.

O. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.

2.6 FABRICATED ITEMS

A. Metal Flashings:
   1. Through Wall Receiver Tray: Minimum 24 gauge stainless steel formed in maximum ten (10) foot lengths, through wall receivers shall not extend past the face of the exterior veneer more than ¾".
   2. Counterflashings: Minimum 24 gauge stainless steel, formed in maximum ten (10) foot lengths.

B. Wind Clips: Minimum 24 gauge stainless steel (or match material of counterflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch. To be installed at all wall flashings and at curb flashing lengths longer than 5 feet.

C. Roof Penetrations:
   1. Umbrella Counterflashing: Two-piece construction of minimum 22 gauge stainless steel, fabricated in accordance with drawings or project requirements.
   2. Flashing Pans:
      a. 24 gauge stainless steel.
      b. Fabricate to provide installed minimum clear inside perimeter dimension of two (2) inches on each side of penetrating element.
      c. Fabricate pans to at least six (6) inches above the finished roof membrane and with 1/4 inch hem at top edge and with four (4) inch flanges. Round all corners of flange.
      d. Fabricate metal bonnets for all pans, NO EXCEPTIONS. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached. On beams and other steel, weld in place bonnets fabricated from 1/4 inch steel plate. Draw band bonnets fabricated from 22 gauge stainless steel may be used on circular projections.

D. Metal Edge / Fascia:

   1. Edge Systems One "One Flash-Thru Drip Edge" for Modified Bitumen Roof Systems: Features a continuous cleat with pre-slotted fastening holes and staggered openings in 40% of the roof flange.
      1) Metal:
         a) .040 inch (1.01 mm) aluminum.
         b) 24 gauge galvanized steel.
      2) Finish:
         a) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
      3) Fascia: Standard 12'-0" lengths with matching concealed joint splice plates.
      4) Splice Plates and 22 gauge galvanized continuous cleats with slotted holes are included
      5) Performance:
         a) 20 Year, 140 mph Wind Warranty.

b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to a design pressure of 276 lbs./ft^2 to comply with the International Building Code.
c) Factory Mutual approved I-285 for wind up lift protection.

2. Edge Systems One “One Gravel Stop” for Modified Bitumen Roof Systems: Features a continuous cleat with pre-slotted fastening holes and staggered openings in 40% of the roof flange.
1) Metal:
a) .040 inch (1.01 mm) aluminum.
b) 24 gauge galvanized steel.
2) Finish:
a) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
3) Fascia: Standard 12’-0” lengths with matching concealed joint splice plates.
4) Splice Plates and 22 gauge galvanized continuous cleats with slotted holes are included
5) Performance:
a) 20 Year, 140 mph Wind Warranty.
b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to a design pressure of 276 lbs./ft^2 to comply with the International Building Code.
c) Factory Mutual approved I-285 for wind up lift protection.

E. Metal Coping
1. Perma-Tite Coping
1) Construction:
a) Metal:
1) .040 inch (1.01 mm) aluminum.
2) 24 gauge galvanized steel.
b) Finish:
1) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
2) Coping Cap: Length of 12’-0”, widths to 24” manufactured to job requirements. True radii may be built to template.
3) Coping Vertical Face and Back Leg: 2 ¼” to 12 ½” manufactured to job requirements.
4) Concealed Splice Plates: 8” wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.
5) Anchor / Support Cleat: 20 gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat normally 12” wide at 4’-0” on center. Mechanically fastened as indicated and detailed.
6) Fasteners: 1 ½” stainless steel with driver.
7) Performance:
a) 20 Year, 140 mph Wind Warranty
b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to comply with the International Building Code.
c) Miami-Dade Approved (No. 13-0419.03 12/11/18) to comply with the "High Velocity Hurricane Zone of the Florida Building Code".

F. Continuous Cleats (where applicable): Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.

G. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24 gauge stainless steel, or as shown or directed otherwise.

H. Angle Termination Bar: Aluminum pressure bar 1/8 inch x one (1) inch.

I. Vent Pipe Flashing: Four (4) pound lead. Provide proper size to fold down inside of pipe a minimum of one (1) inch.

J. Vent Pipe Flashing: Unreinforced, pre-molded thermoplastic membrane pipe boot to suit flashing condition and pipe size. Provide stainless steel pipe clamp and sealant between pipe boot and clamp. Provide sheet metal umbrella flashing with sealant and pipe clamp above top of membrane pipe boot clamp and seal.

K. Gutters / Downspouts / Collector Heads: Seal-Tite Industrial Gutter System by manufacturer.
1. Minimum 0.040 inch thick prefinished aluminum formed in maximum twelve (12) foot lengths.
2. Match dimension of existing. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
3. Seal-Tite Industrial Gutter, including 2” Wide Gutter Straps 24” o.c., Wind Straps 6’-0” o.c.,1/8” Stainless Steel Pop Rivits, and #10 x 2” Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer.
4. Supply Drip Edge at gutter.
5. For Modified Bitumen Systems: Include FlashThrough Drip Edge without Continuous Cleat.
6. 24 gauge galvanized steel with membrane manufacturer’s coating (specify)
7. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
8. Install all anchoring devices as outlined in manufacturer literature.
9. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
10. Gutter Straps and Supports: Minimum 3 per 12’-0” length, .100 inch thick downspout straps: Strap type, like metal, match color.
11. Downspouts: Minimum 0.040 inch thick prefinished aluminum (match color).
12. Downspout straps: Strap type, like metal, match color.
13. Gutter Screen: .050” Aluminum with ¼” dia. perforations
14. Collect Heads: Minimum 0.040 inch thick prefinished aluminum (match color). As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify substrates are smooth and clean to extent required to perform sheet metal work.

B. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set in place.

C. Verify that reglets, nailers, cants, and blocking to receive sheet metal are in place and free of concrete and soil.

D. Do not start work until conditions are satisfactory.

3.2 PREPARATION

A. Field measure site conditions prior to fabrication work.

B. Install starter and edge strips and cleats before starting installation.

3.3 INSTALLATION

A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4 inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Prefabricated corners or transitions are required at changes in direction, elevation, or plane and at intersections. Locate field joints not less than 12 inches, nor more than three (3) feet from actual corner. Laps shall be one (1) inch, riveted and soldered at following locations:
1. Prefabricated corners;
2. transitions;
3. changes in direction, elevation, and plane; and
4. at intersections.

B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners wherever possible; and set units true to line and level as indicated. Install work with laps, joints, and seams which are permanently watertight and weatherproof.

C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.
1. Ensure approved fasteners are used throughout the project.

2. Ensure fasteners are installed in manufacturer pre-punched holes on rails, extrusions, clips and cleats.

3. Ensure sufficient amount of waterblock is applied where appropriate to prevent leaking under rails/extrusions. **Contractor is responsible for cleaning stained brick and remedying for total length of workmanship warranty if waterblock is not installed appropriately.**

D. Separations: Provide for separation of metal from dissimilar metal or corrosive substrates by coating concealed surfaces with zinc chromate, bituminous coating, or other permanent separation at locations of contact as recommended by manufacturer or fabricator. Do not use materials which are incompatible with roofing system.

E. Cleat: At exposed edges of perimeter edge, fascias, cap flashings, and where required, attach cleat with appropriate fasteners supplied by roof edge manufacturer. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.

F. Counterflashing:
1. Do not use surface mount counterflashing except as noted in drawings.
2. Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
3. Coordinate installation of through-wall flashing with the masonry contractor.
4. Seal through-wall in conjunction with masonry wall waterproofing.
5. Install wind clips 30 inches o.c. at all counterflashing over five (5) feet in length.

G. Pitch Pans, Metal Flanges (As Required):
1. Apply mastic under pitch pan or metal flashing flange at least 1/2 pound per linear foot.
2. Prime all metal flanges with asphalt primer prior to flashing installation.

3. Clean all projections enclosed in pitch pans in any manner suitable and coated with a rust inhibitive coating as approved by the Architect. Coating shall be allowed to dry prior to pitch pan fill.
4. Fill base of pitch pans with grout or cementitious binder and allow to cure.
5. Top Finish Fill: Self-leveling, one-part urethane; at least two (2) inches to top of pitch pan sides.
6. Strip in pitch pan flanges with two strips of specified stripping plies set in hot bitumen extending three (3) inches from the outer edge of the flange to at least three (3) inches inward toward base of pitch pan. Provide finish stripping ply of SBS modified bitumen membrane in hot bitumen extending six (6) inches from the outer edge of the flange and butt to base of pitch pan.

H. Sanitary Vent Stacks (As Required): Modified Bitumen Roof System
1. Prime top and bottom flanges of lead flashing sleeve. Set flange in uniform troweling of plastic roof cement. Prime top side of flange to receive strip-in membrane.
2. Fold lead sleeve down inside of pipe a minimum of one (1) inch. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve.

I. Gutters / Downspouts:
1. Install gutters prior to edge metal and otherwise as detailed.
2. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (3) feet on center (note: 3 per 12’ lengths supplied by manufacturer.
3. Install splash pad or block under discharge port of downspouts (if non exist). Install splash pan over a protection (walkway) pad for downspouts located at roof level.

3.4 CLEANING AND PROTECTION

A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean of stains.

B. Remove scraps and debris and leave work area clean.

C. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on pre-finished metal by painting with a compatible paint in color to match undamaged finish.

D. Prime soldered area of phosphatized metal after cleaning to prevent rusting.

E. Paint metal flashings that have been soiled with bitumen with aluminized paint.

F. Clean other work damaged or soiled by Work of this Section.

G. Protect finished work from damage.

END OF SECTION

SECTION 07 65 00 - FLEXIBLE FLASHING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Provide flexible flashing where shown on drawings or required.

1.3 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete
B. Section 04 20 00 – Unit Masonry
C. Section 07 27 26 – Fluid Applied Air Barrier System
D. Section 07 41 13 – Prefinished Metal Roofing
E. Section 07 54 19 – Fully Adhered TPO Hybrid Membrane Roof System
F. Section 09 21 16 – Gypsum Wallboard Systems (Exterior Sheathing)

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer's installation instructions.

B. Certification: Manufacturer's affidavit that materials used in Project contain no asbestos.

C. Compatibility: Submit letter from primary Fluid Applied Air Barrier System Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Flexible flashing materials used shall be compatible with and not void any warranties of the air barrier system used. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 MATERIALS

A. Flashing:
   1. Copper Laminated Flashing (Contractor's Option – in lieu of asphalt-free copper fabric flashing):
      a. Flashing: A full sheet of copper weighing five (5) ounces per square foot coated or bonded on both sides with one (1) of the following:
         1) Modified asphalt compound coated.

2) Asphalt saturated, waterproof glass fiber laminated fabric.

b. Approved Manufacturers:
1) Advanced Building Products, Inc.
2) Hohmann & Barnard, Inc.
3) Sandell Manufacturing Company, Inc.
4) York Manufacturing, Inc.

c. Mastic: Manufacturer recommended asphalt troweled mastic for sealing copper laminated flashings

2. Asphalt-free Copper Fabric Flashing (Contractor's Option – in lieu of copper laminated flashing):
a. Glass fabric scrim bonded to a full sheet of copper for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
b. Approved Product / Manufacturer: Multi-flash 500 as manufactured by York Manufacturing, Inc.; or Copper-Fabric NA or Copper-Fabric SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).

3. Asphalt-free Stainless Steel Flexible Flashing (Contractor's Option – in lieu of copper laminated or asphalt-free copper fabric flashing):
a. Flexible minimum 2 mil thickness, Type 304 steel sheet with factory applied adhesive with a release liner on one side for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
b. Approved Product / Manufacturer: York 304 as manufactured by York Manufacturing, Inc.; or Mighty-Flash-SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).

4. Membrane Flashing:
a. Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by Manufacturer.
b. Approved Products / Manufacturers:
1) "CCW-705 TWF" manufactured by Carlisle Coatings and Waterproofing
2) "Perm-A-Barrier" manufactured by W. R. Grace & Co.
3) "Blueskin TWF" manufactured by Henry Co.
4) "Air-Shield Through wall flashing" manufactured by W.R. Meadows, Inc.
5) ""TW-Thru Wall Flashing" manufactured by Tamko Waterproofing.
6) AquaFlash 500" manufactured by Fiberweb.

5. Substrate Primer: Provide as instructed by Membrane Manufacturer.
6. Termination Bar: 14 ga. minimum thick by 1" minimum wide stainless steel, with pre-punched holes and ¼" minimum shouldered top flange. Provide with self-tapping screws.
7. Weathering Flange at Door / Window Openings: Provide a 20 gauge (0.040") stainless steel or .040 aluminum 2"x3" weathering flange at head, jamb and under sill pan of storefront window and hollow metal door systems. Screw attach into wood blockings or substrate walls and strip into air barrier system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Flashing:

1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
2. Application Guidelines - Install flashing at the following locations:
   a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge / exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck / exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.

   b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill / weep conditions, exterior door and window head / weep conditions, intermediate and / or shelf angles, masonry wall cap flashing and masonry wall base flashing.
3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
4. Provide drip edge flashing at weep conditions with membrane flashing. Cut ¼" to ½" behind with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar or in a full bed of mastic and topped with a fresh full bed of mortar. The flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
8. Thru-Wall Flashing: Shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
9. Lintel: Premolded or field molded end dams must be provided at each end of all lintels.
10. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
11. Heads, Jambs and Sills: Flashing for heads and sills shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill

flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Jambs are to be turned into the buildings to complete seal perimeter of window or door. Install weepholes.

12. Windows: wrap all heads, sills and jambs into opening with flexible flashings.
13. Wood blockings: Flexible flashings are to cover wood blockings in their entirety.
14. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
15. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
16. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
17. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
18. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
19. Reglet Termination: Insert wedge into place and seal carefully with adhesive.
20. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
21. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full 1/8 inch protective coating or mastic on all flashing faces.
22. Lintels: Provide pre-molded end dams at all lintel ends.

B. Bed Joints: Coordinate work with Division 4, Masonry. Install thru-wall flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back 3/4 inch from face of masonry.

3.2 APPLICATION

A. Protect membrane from overexposure to direct sunlight.

B. Follow manufacturer’s recommendations for installation.

C. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.

END OF SECTION 07 65 00

SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Pre-finished galvanized steel gutters and downspouts.
   2. Precast concrete splash pads.
   3. Sheet metal splash pans.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications: Metal downspout boots and downspout guards.
   2. Section 07 61 00 - Sheet Metal Roofing: Standing seam metal roofing.
   3. Section 07 62 00 - Roof Related Sheet Metal.

1.3 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM B32 - Standard Specification for Solder Metal; 2020.

D. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

E. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

F. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

G. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

H. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.

B. Comply with applicable code for size and method of rain water discharge.

C. Maintain one copy of each document on site.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on prefabricated components.

C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

D. Samples: Submit two samples, 6 inch (150 mm) long illustrating component design, finish, color, and configuration.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

B. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.

C. Prevent contact with materials that could cause discoloration, staining, or damage.

1.7 WARRANTY

A. Manufacturer's Product Warranty:
   1. Manufacturer's standard 30-year finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
   2. Failure is defined to include, but not be limited to:
      a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
   3. Correction may include repair or replacement of failed product as outlined in Warranty Documents
   4. Finish warranty and wind warranty shall be delivered by the Contractor to the Owner at the conclusion of project as part of project closeout documents.

B. Contractor’s Warranty:
   1. The Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the gutters, downspouts, and conductor heads will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
   2. Defects shall include, but not be limited to:
      a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
      b. Leaking water or bitumen within building or construction.
      c. Becoming loose from substrate / blocking.
      d. Loose or missing parts.
      e. Finish failure as defined above.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Gutters and Downspouts:
      a. Alside, Inc: www.alside.com.
      b. ATAS International, Inc.: www.atas.com.
      c. Cheney Flashing Company: www.cheneyflashing.com/.
      d. Drexel Metals Inc: www.drexmet.com.
      e. Hickman Edge Systems: www.hickmanedgesystems.com.
      f. Metal-Era, an MTL Company: www.metalera.com.
      g. SAF Perimeter Systems, a division of Southern Aluminum Finishing Company, Inc: www.saf.com/persys.
   2. Scupper and Collectors:
      a. ATAS International, Inc.: www.atas.com.
      b. Metal-Era, an MTL Company: www.metalera.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum: AWS D1.2/D1.2M.

b. Sheet Steel: AWS D1.3/D1.3M.
c. Stainless Steel: AWS D1.6/D1.6M.
d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS

A. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch (0.6 mm) thick base metal.
   1. Finish: Shop pre-coated with modified silicone coating.
   2. Color: As indicated on Drawings.

B. Protective Backing Paint: Zinc molybdate alkyd.

C. Solder: ASTM B32; Sn50 (50/50) type.

2.4 COMPONENTS

A. Basis of Design Product:
   1. Seal-Tite Industrial Gutter IG-B manufactured by Metal-Era.

B. General Requirements:
   1. Minimum 24-gauge prefinished galvanized steel, formed in maximum 12 foot lengths.
   2. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
   3. Install all anchoring devices as outlined in manufacturer literature.

C. Gutters:
   1. Profile as indicated on Drawings.
   2. Form in maximum lengths of 12 feet.
   3. Supply Drip Edge at gutter.
   4. For Single Ply roofing systems: Drip Edge with Factory Applied Flashing (PVC).
   5. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
   6. Gutter Straps and Supports: Minimum 3 per 12 foot length, 0.100 inch thick downspout straps: Strap type, like metal, match color.
   7. Gutter Screen: 0.050 inch Aluminum with 1/4 inch dia. perforations.

D. Downspouts:
   1. Profile as indicated on Drawings.
   2. Downspouts: Minimum 24-gauge prefinished galvanized steel (match color).

E. Scuppers and Collectors:
   1. Profile as indicated on Drawings.
   2. Collecter Heads: Minimum 24-gauge prefinished galvanized steel (match color). As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.

F. Anchors and Supports:
   1. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets, and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
   2. Anchoring Devices: As recommended by fabricator.
   3. Gutter Supports: 2 inch Wide Gutter Straps at 24 inches o.c., Wind Straps 6 feet o.c.,1/8 inch Stainless Steel Pop Rivits, and #10 by 2 inch Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer..
   4. Downspout Supports: Strap type, like metal, match color.

G. Accessories:
   1. Splash Pads: Precast concrete type, size and profiles indicated; minimum 3,000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.
   2. Downspout Boots: Refer to Section 05 50 00 - Metal Fabrications.
   3. Downspout Guards: Refer to Section 05 50 00 - Metal Fabrications.

2.5 FABRICATION

A. Form gutters and downspouts of profiles and size(s) indicated on Drawings.

B. Fabricate with required connection pieces.

C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.

D. Hem exposed edges of metal.

E. Fabricate gutter and downspout accessories; seal watertight.

2.6 FINISHES

A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604, multiple coat, thermally cured fluoropolymer finish system; color as selected by Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that surfaces are ready to receive work.

3.2 PREPARATION

A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.381 mm).

3.3 INSTALLATION

A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.

B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.

C. Slope gutters ____ inch per foot (____ mm/m) , ___ percent minimum.

D. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

E. Connect downspouts to downspout boots at ____ inches (____ mm) above grade. Grout connection watertight.

F. Set splash pans under downspouts. Secure in place with _____ .

END OF SECTION 07 71 23

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 INSTALLATION RESPONSIBILITY

A. In addition to the items normally a part of this Section, coordinate the installation of roof accessory curbs and pipe flashings and equipment supports that may be specified elsewhere.

B. Coordinate the Work specified herein with the following Work:
   1. Roofing
   2. Roofing sheet metal
   3. Mechanical equipment
   4. Plumbing
   5. Electrical

1.3 REFERENCES

A. Federal Specifications (FS)
   1. TT-S-00227E

B. National Roofing Contractors Association (NRCA)

C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
   1. Architectural Sheet Metal Manual

1.4 SUBMITTALS

A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

C. Contractor to provide proof of membrane material compatibility for roof bracing and supports.(Refer to section 2.6)

1.5 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination.

1.6 WARRANTY

A. Warranty the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:
   1. Noticeable deterioration of finish
   2. Water infiltration into the building or within the construction.

C. Rooftop supports – 5 year limited warranty.

D. Roof bracing – 20 year limited warranty included in roofing warranty.
   1. Water infiltration into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Specifications are based on products of named manufacturers. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 PREFABRICATED ROOF CURBS

A. Frames:
   1. Material: ASTM A 653 G90 hot-dipped galvanized steel.
      a. Minimum 18 gauge, and as engineered by manufacturer.
      b. Minimum 18 gauge for curbs supporting HVAC units
      c. Minimum 20 gauge for expansion joint curbs.
   2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
   3. Base Plates: Integral to frame and welded.
   4. Internally reinforced with galvanized 1 inch by 1 inch by 12 gauge angles for curbs exceeding 3 foot length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
   5. Wood Nailers: Factory installed, pressure treated. Size and width as suitable for support of items installed on curbs.

B. Insulation: Factory installed 1-1/2 inch thick three-pound density fiberglass insulation.

C. Curb Height: Minimum 8 inch above finished roof.
   1. Construct curbs to match roof slope with plumb and level top surface for mounting mechanical equipment.

D. Gasketing: 1/4 inch thick, one (1) inch wide at roof top units.

E. Counterflashing: 24 gauge stainless steel

F. Counterflashing Cap: Stainless steel.

G. Cants:
   1. Non-canted curb style installs either under or on top of metal decks with insulation.
   2. Cants shall be provided under Section 07 52 19 – Roofing

H. All insulated roof curbs shall be structural and shall include calculations signed and sealed by a registered Structural Engineer. Refer to installation drawings for any additional structural requirements. If curbs do not span a minimum of two bar joists, only two angles will be required. Coordination mechanical equipment weight loading on the roof with Structural Engineer.

I. Approved Manufacturers:

1. Custom Curb, Inc.
2. Roof Products, Inc.

2.3 PIPE SUPPORTS (Contractor built supports are not allowed)

A. Gas Pipe Supports:
1. Provide pipe roller type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10” x 16” x 3”; 5.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-R with roller for gas pipe 3” O.D. and smaller.
2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12” x 12” x 3”; 3 lbs. each or 18” x 18” x 3”; 7 lbs. each or 18” round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for gas pipe larger than 3” O.D.
3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.

B. Electrical Conduit / Condensate Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10” x 16” x 3”; 5.5 lbs. each) and stainless steel channel, rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-C with channel for condensate pipe or conduit 3” O.D. and smaller.
2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12” x 12” x 3”; 3 lbs. each or 18” x 18” x 3”; 7 lbs. each or 18” round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for condensate pipe or conduit larger than 3” O.D. Contractor to provide channel clamp at each support. Provide dissimilar metal protection as required.
3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.

C. Chilled Water Pipe Supports:
1. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (18” x 18” x 3”; 7 lbs. each or 18” round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 or Model PS-2-2 or Model PSE Custom as required with hanger(s) for chilled water pipe of any diameter.
2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.

D. Crossover / Steps Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors and stainless steel channel, rods, washers and nuts; Basis of design, PHP Crossover.
2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.

E. Installation:
1. Provide pipe supports at no greater than 8’-0” o.c. or as otherwise indicated in Manufacturer’s Shop Drawings.
2. Provide pipe supports spaced so deflection of piping does not exceed 1/240 of span. If deflection exceeds 1/240 of span, decrease support spacing to 6’-0” o.c.
3. Provide complete and adequate support of all piping, ducts and conduit.

4. Provide protective isolation pads adhered to the roof system below each pipe support using Roof System Manufacturer's approved adhesive.
5. Provide each pipe support adhered to the protective isolation pads using Roof System Manufacturer's approved adhesive.

2.4 ROOF TO ROOF EXPANSION JOINT

A. Stainless Steel expansion joint covers on new wood curbs, as detailed on drawings and outlined the NRCA and SMACNA manual.

2.5 ROOF PENETRATION HOUSING

A. Provide rain-proof our-piece configuration consisting of a removable vandal resistant lid, middle housing, insulation extension (ICE) and wide flanged curb that is light weight and water tight. To be used with our exclusive two-piece aluminum and / or stainless steel flanged Exit Seal with SilX14TM gasket. Provide 20 Year insured warranty.

B. As manufactured by Roof Penetration Housing Model AWI Series Vault as required for condition or Architect approved equal.

2.6 ROOF DRAIN / DOWNSPOUT WALL NOZZLE

A. Downspout Wall Nozzle at Concealed Roof Drain Leader / Discharge: Josam 25010 Series cast bronze Downspout Nozzle with loose flange and inlet threaded connection or Architect approved equal. Diameter appropriate to downspout size.

2.7 PLUMBING PEDESTAL HYDRANT

A. Provide freeze-proof pedestal hose station / hydrant with stainless steel shroud, welded stainless steel flange, black powder coated cast aluminum dome handle, mail hose fitting and vacuum breaker. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.

B. As manufactured by MAPA Products Model MPH-24D:24/9 Pedestal Hydrant as required for condition or Architect approved equal.

2.8 ELECTRICAL PEDESTAL DISCONNECT / OUTLET

A. Provide rain-proof pedestal disconnect with stainless steel square tubing and welded stainless steel flange. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.

B. As manufactured by MAPA Products Model MPD-(XX) Pedestal Disconnect as required for condition or Architect approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof accessories in accordance with manufacturer's printed instructions and approved shop drawings. Installation of Portable Pipe Hangers shall not exceed six (6) feet on center.

B. Coordinate with roofing operation for watertight integrity.

C. Finished installation shall be water and air tight. Install sealant conforming to FS TT-S-00227E, Type II, Class A.

END OF SECTION

SECTION 07 72 33 - ROOF SCUTTLE (HATCHES)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

A. Section 03 52 16- Lightweight Insulating Concrete Deck System

B. Section 05 31 00 - Metal Deck

C. Section 05 50 00 - Miscellaneous Metals

D. Section 06 10 00 - Rough Carpentry

E. Section 07 54 19 – Fully Adhered Thermoplastic Membrane Roofing System

1.3 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a watertight installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 SUBMITTALS

A. Product Data: Submit schedules, charts, literature and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

B. Shop Drawings: Include materials, opening sizes, fabrication details, hardware, attachments, related and adjacent work, and finishes.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Miami-Dade County, FL Approved NOA
   a. TAS 201 Impact test
   b. TAS 202 Uniform Static Air Pressure
   c. TAS 203 Cyclic Wind Pressure Loading
2. OSHA 29 CFR 1910.23 Guarding floor and wall openings and holes
3. OSHA 29 CFR 1926.502 Fall protection systems criteria
4. International Building Code (IBC) Section 1013.6 Roof Access
5. International Building Code (IBC) Section 1009.11 Means of Egress, Stairways, Stairway to Roof
6. International Building Code for venting requirements
7. IBC Section 410 for Stages and Platforms
8. IBC Section 910 for Factory and Storage occupancies
9. IBC Section 1207 Sound Transmission
10. Underwriters Laboratories Inc, UL 793 Listed for Heat and Smoke Vents
11. FM Global, Factory Mutual, FM 4430 Heat and Smoke Vents for Roofs

12. Reference NFPA 204 for general maintenance of Heat and Smoke vents
13. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site ready use.

B. Exercise proper care in handling of Work so as not to disrupt finished surfaces.

C. Store materials under cover in a dry and clean location off the ground.

1.7 WARRANTY

A. Warrant the work specified herein for five (5) years, against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:
1. Faulty, improper or inadequate attachment or installation.
2. Difficult or noisy operation.
3. Noticeable deterioration of finish.
4. Leakage of water into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis of Design Product: Subject to compliance with requirements: The Bilco Company.

B. Manufacturers listed below whose products are equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. SafePro products
2. Acudor Products Inc.
3. Babcock-Davis Hatchways, Inc.
4. Dur-Red Products
5. J. L. Industries, Inc.
6. Karp Associates, Inc.
7. Nystrom Building Products

2.2 ROOF SCUTTLES (HATCHES)

A. Size: 2’-6” x 4’-6”, unless shown otherwise.

B. Finish: Mill Finish Aluminum

C. Thermally Broken Cover: Shall be 11 gauge aluminum with 3" concealed polyisocyanurate insulation, 5" beaded, overlapping flange, fully welded at corners, and internally reinforced for 40 psf live load., fully covered and protected by an aluminum liner. No water standing on top of the cover will be permitted.

D. Thermally Broken Curb: Shall be 12 inches in height above finished roof surface and constructed of 11 gauge aluminum. It shall be formed with a 5-1/2 inch flange with holes provided for securing to the roof deck. Curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, full welded at the corners for weathertightness. Capflashing shall be equipped with the Bilclip™ flashing system, including stamped tabs and Pak-Rope. Insulation on the exterior of the curb shall be rigid fiber board three (3) inches in thickness.

E. Thermally Broken Scuttle (Hatch): Shall be completely assembled with heavy pintle hinges, positive snap latch with turn handles, padlock hasps inside and outside, and a mechanically retained thermoplastic rubber gasket. Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. Cover shall be equipped with an automatic hold-open arm complete with red vinyl grip handle to permit easy release and one-hand control of the cover to its closed and latched position. All hardware shall be stainless steel. Gasket shall be extruded EPDM adhesive back seal and continuous around cover.

F. Approved Model / Manufacturer: Type No. “S-50TB” Roof Scuttles (Hatches) for ladder access, or Architect approved equal.

G. Roof Access Ladder: As specified in Section 05 50 00, Miscellaneous Metals. Ladder shall be oriented and mounted along the short dimension of the hatch.

H. Fall Protection Safety Rail: 30”x54” Model SP 3054 manufactured by **SafePro L.C.** Guardrail height shall be 42” above finished roof surface. Color shall be powder coated to match associated metal panels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate installation of sealant and roofing cement with Work of this Section to ensure water tightness.

B. Coordinate installation of components of this Section with installation of roof deck, roof structure, roofing membrane, and base flashing.

C. Roof hatches shall be welded to structural steel frame of building.

D. Install hatches in accordance with details on drawings, approved shop drawings, and manufacturer’s instructions.

E. Set units plumb, level, and true to line without warp or rack. Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

F. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a watertight and airtight seal.

3.2 FIELD QUALITY CONTROL

A. Test for proper operation after installation by one or all of the operational methods.

B. Pull internal and / or external manual pull handles and then close vents from the exterior at the roof top level.

C. Do not paint the internal mechanisms, especially moving parts such as spring, dampers, rotary latches and especially the fusible links. Painting any of these components may damage the vents and will void the warranty.

3.3 ADJUSTING

A. Adjust movable parts for smooth operation.

B. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation

3.4 CLEANING

A. Clean exposed surfaces per manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 07 72 33

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Control and expansion joints on exposed surfaces.
   2. Perimeter joints between wall surfaces and frames of doors and openings.
   3. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   4. Joints indicated or as necessary.
   5. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

A. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.

B. ASTM C834 - Standard Specification for Latex Sealants; 2017.

C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2018.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

E. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2018.

H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.

I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).

J. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018.

K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

L. ASTM E2129 - Standard Practice for Data Collection for Sustainability Assessment of Building Products; Current.

1.4 SUBMITTALS

A. Product Data: Technical data for each joint sealant product. Submit written certification from manufacturers of sealants attesting products are suitable for use indicated, verified through in house testing laboratory.
   1. Written certification from manufacturers of joint sealants attesting that products comply with specification requirements and suitable for use indicated verified through manufacturers testing laboratory within the past 36 months or since most recent reformulation, whichever is most recent.
      a. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of sealant.
      b. Manufacturer's letter, clearly indicating proposed lot numbers of each sealant supplied and expiration date sequence.
      c. Instructions for handling, storage, mixing, priming, installation, curing, and protection of each type of sealant.

2. VOC Data: Submit manufacturer’s product data for sealants. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
3. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.

B. Certificates and Reports:
1. Product Certificates: Manufacturer's product certificate for each kind of joint sealant and accessory.
2. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
4. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
   a. Materials forming joint substrates and sealant backings have been tested for compatibility and adhesion with sealants.
   b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
5. Preconstruction Field Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified.
6. Field Adhesion Test Reports: For each sealant application tested.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Firm having minimum 5 years documented experience and specializing in the installation of sealants.
1. Exposed sealant work (sealants used for air and weatherseals external to curtain wall systems at perimeter, metal panel to panel joints) shall be performed by a single (i.e. one) firm specializing in the installation of sealants who has successfully produced work comparable to project.
2. Concealed sealant work (sealants which are internal to metal framed curtain wall systems, skylights, and providing an air seal) shall be the responsibility of the subcontractor providing erection of the respective system.

B. Source Limitations: Obtain each type of joint sealant from a single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
2. Test according to SWRI Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion in peel, and indentation hardness.

D. Environmental Requirements:
1. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials.
   a. VOC Content of Interior Sealants: Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions for VOC limits of sealants installed within the building.
   b. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer written instructions to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F (4.4 degrees C).
   2. When joint substrates are wet. Should joints or backing materials become wet, remove and replace backing material with new.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

A. Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealant work which has failed to provide a weathertight system within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

B. Warranties: Written warranties (weatherseal and stain resistance), signed by sealant manufacturer agreeing to furnish joint sealants to repair or replace those that fail to provide airtight and watertight joints, or fail in adhesion, cohesion, abrasion resistance, stain resistance, weather resistance, durability, or appear to deteriorate in manner not specified in the manufacturer's data as an inherent quality of the material within specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion, 20 years for silicone sealants.

C. Warranties specified exclude deterioration or failure of sealants from:
   1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 MATERIALS

A. Compatibility: Provide joint sealants, backings, and related materials compatible with one another and with joint substrates, air barrier system, and masonry under conditions of service and application, as stated by sealant manufacturer’s published data, and as substantiated by the manufacturer for each application through testing.

B. Liquid Applied Sealants: Comply with ASTM C920 and requirements indicated for each liquid applied sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.

C. Stain Test Response Characteristics: For sealants in contact with porous substrates, provide non-staining products that have undergone testing according to ASTM C1248 and do not stain porous joint substrates.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors: For fully concealed joints, provide standard color of sealant that has the best overall performance characteristics for the application shown. For exposed joints, match adjacent surface. For exposed joints, submit color samples to architect for approval, from manufacture's full line of standard colors.

F. Manufacturer's Representative: Use sealant produced by manufacturer who agrees to send a qualified technical representative to site upon request for the purpose of rendering advice concerning the recommended installation of manufacturer's materials.

G. Sealants: Self leveling compounds for horizontal joints in pavements and non-sag compounds elsewhere except as shown or specified.

H. Silicone Sealant: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
   1. Basis of Design Product:
   2. Use: Precast Concrete Joints between metals, glass, and plastics (Two part silicone sealants).
   3. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion and Peel.
   4. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.

I. Silicone Sealant: ASTM C920, Type S, Grade NS, Class 50, use NT.
   1. Basis of Design Products:
   2. Use: Precast Concrete Joints between metals, glass, and plastics (Single component sealants).
   3. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates.
   4. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.

J. Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
   1. Basis of Design Products:
   2. Use: Typical Wall and Floor Joints (Two part polyurethane sealants).
   3. Properties: Performance: Non-staining, non-bleeding, non-streaking to sealed and adjacent substrates.

K. Two Part Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 50; use NT, M, A and O.
   1. Basis of Design Products:
   2. Use: Typical Wall and Floor Joints (Two Part Polyurethane Sealants).
   3. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion in Peel.

L. Mildew Resistant Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, Substrate uses G, A, and O; and containing fungicide for mildew resistance; acid curing.
   1. Basis of Design Products:

2. Use: Joints at toilet fixtures, toilet room countertops and vanities, wet areas, and janitor closet mop receptor to wall transition.

M. Latex Sealant: Non-elastomeric, one part, non-sag, paintable latex sealant that is recommended for exposed applications on the interior. Complying with ASTM C834, Type OP (opaque sealants):
1. Basis of Design Products:

N. Acoustical Joint Sealant: Non-sag, paintable, non-staining, latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
1. Basis of Design Products:
a. Tremco Acoustical Sealant manufactrued by Tremco.

O. Sealant Backing: Provide sealant backings that are non-staining; compatible with joint substrates, sealants, primers, and joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
1. Basis of Design Products:
2. Cylindrical Sealant Backings: Preformed, compressible, resilient, non-staining, non-waxing, non-extruding backings of flexible plastic foam complying with ASTM C1330, and of type indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.
3. Type C: Closed cell polyethylene foam material with surface skin, nonabsorbent to liquid water and gas, non-outgassing in unruptured state; one of the following:

P. Butyl Mastic Tape: High-tack, self-fusing butyl rubber mastic.
1. Basis of Design Product:
a. Butyl Mastic Tape 2212 manufactured by 3M.
2. Compatible with air barrier system.
3. Locations: At masonry veneer anchors and where indicated on Drawings.

Q. Miscellaneous Materials:
1. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.
2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
3. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surface adjacent to joints to which it is applied.
4. Cork Joint Filler: Resilient and non-extruding ASTM D1752, Type II.
5. Bond Breaker Tape: Polyethylene, TFE fluorocarbon, or plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and conditions affecting sealant performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with the recommendations of joint sealant manufacturer and requirements:

1. Remove foreign material from joint substrates interfering with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), existing joint sealants, oil, grease, water, surface dirt, and frost.
2. Clean concrete, masonry, unglazed surfaces of tile and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.
3. Remove laitance and form-release agents from concrete.
4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on prior testing and experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

A. Silicone Glazing Sealants: Refer to Section 08 80 00 - Glazing.

B. Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

C. Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants applicable to materials, applications, and conditions indicated.

D. Sealant Backings: Install sealant backings to support sealants during application and at position necessary to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings. Trim for tight fit around obstructions or elements penetrating the joint.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that become wet before sealant application and replace with dry sealant backings.
4. Install bond breaker tape behind sealants where backings are not used between sealants and back of joints.

E. Weeps and Vents: Install weeps and vents into joints at the same time sealants are being installed. Locate weeps and vents spaced recommended by sealant manufacturer and the window and curtain wall fabricator and erector. Do not install weeps and vents at outside building corners. Do not install vents at horizontal joints immediately below shelf angles, sills, and through wall flashings.

F. Sealants: Install sealants by proven techniques resulting in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at same time sealant backings are installed.
1. Apply sealants in depth in accordance with manufacturer's recommendations and recommended general proportions and limitations.
2. Apply elastomeric sealants, in joints not subject to traffic or abrasion, to a depth equal to 50% of the joint width, but not less than 1/4 inch (6 mm) and not more than 1/2 inch (13 mm).
3. Apply non-elastomeric sealants to a depth approximately equal to the joint width.

G. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform, beads to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces. Tool exposed surfaces of sealants to the profile shown, or if none is shown, tool slightly concave.
   1. Use masking tape to protect adjacent surfaces of recessed tooled joints.
   2. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.
   3. Against rough surfaces or in joints of uneven widths avoid the appearance of excess sealant or compound by locating the compound or sealant well back into joint wherever possible.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

I. Acoustical Sealant Installation: At sound rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer written recommendations.

3.4 FIELD QUALITY CONTROL

A. Field Adhesion Testing: Field test exterior wall joint sealant adhesion to joint substrates:
   1. Extent of Testing: Test completed and cured sealant joints:
      a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
      b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
   2. Test Method: Test joint sealants according to Method A, Field Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   3. Inspect tested joints and report on the following:
      a. Whether sealants filled joint cavities and are free of voids.
      b. Whether sealant dimensions and configurations comply with specified requirements.
      c. Whether sealants in joints connected to pulled out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer field adhesion hand pull test criteria.
   4. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
   5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure original sealant surfaces are clean and new sealant contacts original sealant.

B. Evaluation of Field Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 SITE ENVIRONMENTAL PROCEDURES

A. Indoor Air Quality: Provide temporary ventilation during work. Coordinate interior application of sealants with interior finishes schedule.

3.6 CLEANING AND PROTECTION

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

B. Protect joint sealants during and after curing from contact with contaminating substances and from damage so sealants are without deterioration or damage at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Provide items shown on the Drawings and specified, including, but not limited to the following:
   1. Standard steel doors for interior or exterior use.
   2. Opening protective steel doors for interior or exterior use.
   3. Thermally-insulated doors for interior or exterior use.

B. Related Sections:
   1. Section 05 40 00 - Cold Formed Metal Framing.
   2. Section 07 92 00 - Joint Sealants.
   3. Section 08 80 00 - Glazing.
   4. Section 09 21 16 - Gypsum Board Assemblies.
   5. Section 09 24 00 - Cement Plastering.
   6. Section 09 90 00 - Painting and Coating.

1.3 REFERENCE STANDARDS

A. ANSI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes; 2018.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2022a.

D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

E. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus; 2019.

F. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

I. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

J. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

K. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

L. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

M. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

N. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data:

1. Manufacturer's standard details and catalog data demonstrating compliance with specifications and referenced standards.
2. Manufacturer's installation instructions.

B. Shop Drawings:
1. Indicate complete schedule in detail for each steel door and frame using the same reference number for details and openings as those on the contract Drawings. If any door is not by the steel door manufacturer, only the door opening number should be shown along with the type of door (wood, plastic laminate faced, etc.):
a. Show details of construction, installation, connections, anchors, hardware reinforcement, hardware preparation, louvers, and floor and threshold clearances.

C. Samples are required from non-Steel Door Institute members:
1. 12 inch by 12 inch sample of a fire-rated and non-rated door, cut from corner of door, showing door construction.
2. 12 inch by 12 inch sample of each type of door louver specified or required, showing louver construction.
3. 6 inch long sample of a fire-rated, non-rated frame, and each type of glass stop specified or required, showing corner and construction.

D. Certificates: Manufacturer’s certification that oversized openings are in compliance with specifications.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A company specializing in the manufacturer of steel doors and frames of the type specified for this Project with a minimum of 5 years’ experience.

B. All steel doors and frames shall be by a single manufacturer, shop drawings to be submitted with manufacturer’s insignia, which is being supplied.

C. Furnish steel doors and frames to meet current ANSI/Steel Door Standards.

D. Windstorm Resistance: Comply with ANSI A250.13.

E. Structural Performance: Comply with ASTM E330/E330M.

F. Air Leakage: Comply with ASTM E283/E283M.

G. Regulatory Requirements:
1. Fire-Rated Assemblies:
a. Opening protective door, panel, frame, and fire window construction shall conform to NFPA 252, or UL 10B, as applicable, and acceptable to the code of authorities having jurisdiction.
b. Opening Protective Door Construction:
1) Notwithstanding any other requirements of this Section, provide gauge of metal, method of construction, hardware preparation, reinforcement, and placement, glass opening size, and other specifics required to obtain the specified or required label. The label shall contain the fire resistance rating (20 minute, 45 minute, 1 hour, 1-1/2 hour, 3 hour, etc.) and the designation (A, B, C, D, or E); doors with B Label being 1-1/2 hour.
2) Fire-rated doors used in a stairway enclosure, shall be so constructed so that the maximum transmitted temperature shall not exceed 450 degrees F above ambient temperature at the end of 30 minutes of the Standard Fire Exposure Test and shall be so noted on the label.
c. Opening Protectives Hollow Metal Doors:
1) Conform to NFPA 80 for fire-rated class shown or required by code of authorities having jurisdiction:
(a) Units shall be identical to assemblies whose fire resistance characteristics have been determined in accordance with requirements specified above,

and shall be labeled and listed by UL, WHI, or other inspection and testing agency acceptable to the code of authorities having jurisdiction.

(b) Fire-rated steel doors, panels, frames, and fire windows shall bear permanent labels attesting to fire resistance. At stairway enclosures, provide units listed for 450 degree F maximum temperature rise rating for 30 minutes of exposure.

(c) Oversized openings shall be constructed in accordance with all applicable requirements for labeled door construction.

(d) Fire rated door assemblies with gaps in excess of 1/8 inch between door and frame will not comply with NFPA 80.

(e) Locate label on hinge side of doors and frames so that when door is closed, label is not visible.

(f) Caution shall be taken to ensure that labels are not removed, damaged, or painted over.

(g) Glass panes shall not exceed sizes allowed whether indicated or not on the Drawings.

2. Wind Loads:
   a. Provide hollow metal and door hardware assemblies approved by Authorities Having Jurisdiction (AHJ), including anchorage, capable of withstanding wind load design pressures calculated for this Project by a registered Engineer and are part of the construction documents.

H. Pre-Installation Conference: Refer to Section 01 31 00 - Project Management and Coordination.

1.6 WARRANTY

A. Warrant the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.

B. Defects shall include, but not be limited to:
   1. Use of incorrect materials in opening.
   2. Incorrect labeled components installed within opening.
   3. Noisy, rough, or difficult operation.
   4. Failure to meet specified quality assurance requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in accordance with manufacturer’s instructions, and as follows:
   1. In manufacturer's original, clearly labeled, undamaged containers or wrappers.
   2. Containers or wrappers shall list the name of the manufacturer and product.

B. Deliver materials to allow for minimum storage time at the Project site. Coordinate delivery with the scheduled time of installation.

C. Protect products from moisture, construction traffic, and damage:
   1. Store under cover in a clean, dry place, protected from weather and abuse.
   2. Store in a manner that will prevent rust or damage.
   3. Store doors in a vertical position, spaced with blocking to permit air circulation.
   4. Do not use non-vented plastic or canvas shelters.
   5. Should containers or wrappers become wet, remove immediately.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Ceco Door, an ASSA ABLOY company: www.cecodoor.com
   2. CURRIES, an ASSA ABLOY company: www.curries.com
   3. Pioneer Industries, Inc., an ASSA ABLOY company: www.pioneerindustries.com

4. Republic Builders Products Company: www.republicdoor.com
5. Steelcraft Mfg. Co., an Allegion company: www.steelcraft.com

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

A. Regulatory Requirements:
1. Code Standards:
a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
2. Welding Qualifications: Qualify procedures and personnel according to the following:
a. Aluminum: AWS D1.2/D1.2M.
b. Sheet Steel: AWS D1.3/D1.3M.
c. Stainless Steel: AWS D1.6/D1.6M.
d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS, GENERAL

A. Exterior frames and interior frames where shown on Drawings or required in damp, moist, humid, and wet areas, i.e., toilets, locker rooms, showers, etc., to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel and galvannealed to A60 minimum coating weight standard per ASTM A653/A653M and ASTM A924/A924M, with coating weight of not less than 0.60 ounce per square foot (183 grams per square meter).

2.4 FRAME FABRICATION

A. Minimum Gauges:
1. Interior:
a. Openings less than 4 feet wide: 16 gauge.
b. Openings 4 feet in width and greater: 14 gauge.
2. Exterior: 14 gauge.

B. Design and Construction:
1. Frames shall be custom made, welded units with integral trim of sizes and shapes shown on approved shop drawings. Hinge jambs that butt adjacent 90 degree walls shall have at least 4 inch (102 mm) wide frame face to assure the door trim will not strike the wall prior to the door opening at least 90 degrees. Frame profile shall match wall thickness where practical, i.e., 4-3/4 inch (121 mm) at 4 inch (102 mm) CMU, 6-3/4 inch (171 mm) at 6 inch (152 mm) CMU, and 8-3/4 inch (222 mm) at 8 inch (203 mm) CMU. At masonry wall openings, fabricate frames to suite masonry opening with 2 inch (51 mm) head member.
2. Frames shall be strong and rigid, neat in appearance, square, true, and free of defects, warp, and buckle. Molded members shall be clean cut, straight, and of uniform profile throughout their length.
3. Jamb depths, trim, profile, and backbends shall be as shown on approved shop drawings.
4. Corner joints, including face and inside corners, shall have contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets shall not be permitted. Face of frame shall be ground smooth. Knockdown (KD) frames are not permitted.
5. Minimum depth of stops shall be 5/8 inch (16 mm), except at fire windows where minimum depth of stops shall be 3/4 inch (19 mm).
6. Frames for multiple openings shall have mullion and rail members that are closed tubular shapes having no visible seams or joints. Joints between faces of abutting members shall be securely welded and finished smooth. Mullions shall be key locked removable type. Keys shall be master keyed to the Owner's key system.

7. High-Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48 inches (1,219 mm) and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
8. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 08 71 00 - Door Hardware.
9. Provide countersunk flat or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops; provide security head screws at exterior locations.
10. Provide A60 galvannealed coating at frames in the following locations:
    a. Restrooms.
    b. Locker rooms.
11. Electrical Knock Out Boxes:
    a. Factory weld 18 gauge electrical knock out boxes to frame for electrical hardware preps; included but not limited to electric thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnetic licks as noted in door hardware sets in Section 08 71 00 - Door Hardware:
        1) Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations.
        2) Provide electrical knock out boxes with 3/4 inch knockouts.
        3) Conduit to be coordinated and installed in field from middle hinge box and strike box to door position box.
        4) Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Section 08 71 00 - Door Hardware.
        5) Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
        6) Provide field installed conduit per Division 28 - Electronic Safety & Security Section for standardized plug connectors to accommodate up to 12 wires as required for electrified door hardware specified in hardware sets in Section 08 71 00 - Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
12. Hardware reinforcements:
    a. Frames shall be mortised, reinforced, drilled, and tapped at factory for fully template mortised hardware in accordance with approved hardware schedule and templates provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.
    b. Minimum thickness of hardware reinforcing plates shall be as follows:
        1) Hinge and pivot reinforcements (1-1/4 inch (32 mm) by 10 inch (254 mm) minimum size): 7 gauge.
        2) Strike Reinforcements: 12 gauge stiffeners.
        3) Flush Bolt Reinforcements: 12 gauge.
        4) Closer Reinforcements: 12 gauge.
        5) Reinforcements for surface-mounted hardware, hold-open arms, and surface panic devices: 12 gauge.
13. Floor Anchors: Minimum 14 gauge, securely welded inside each jamb, with holes for floor anchorage.
14. Jamb Anchors:
    a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the T-strap type. Anchors shall be not less than 16 gauge steel. The number of anchors provided at each jamb shall be as follows:
        1) Frames up to 7 feet 6 inches (2,286 mm) in height: Three anchors.
        2) Frames 7 feet 6 inches (2,286 mm) to 8 feet (2,438 mm) in height: Four anchors.

3) Frames over 8 feet (2,438 mm) in height: One anchor for each 2 feet (610 mm) or fraction thereof in height.

b. Frames for installation in wood or metal stud partitions shall be provided with steel anchors of suitable approved design, not less than 16 gauge thickness, securely welded inside each jamb as follows:
   1) Frames up to 7 feet 6 inches (2,286 mm) in height: Four anchors.
   2) Frames 7 feet 6 inches (2,286 mm) to 8 feet (2,438 mm) height: Five anchors.
   3) Frames over 8 feet (2,438 mm) in height: Four anchors plus one additional for each 2 feet (610 mm) or fraction thereof over 8 feet (2,438 mm).

c. Frames to be anchored to previously placed concrete, masonry, or structural steel shall be provided with anchors of suitable design as shown on approved shop drawings.

15. Dust Cover Boxes: Shall be of not less than 26 gauge steel and shall be provided at all mortised hardware items. 8 inch (203 mm) CMU walls with face brick shall have dual offset jamb anchors.
16. Steel Spreader: Shall be provided on all frames, temporarily attached to bottoms of both jambs for bracing during shipping and handling.
17. Loose glazing stops: Shall be of cold rolled steel, not less than 20 gauge, butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws. Loose stops at exterior frames shall be placed on the interior side of the frames.
18. At sound rated door openings and at masonry openings, coat inside of frame profile with corrosion resistant coating to minimum thickness of 1/16 inch (1.6 mm).

C. Frame Color: Field paint under Section 09 90 00 - Painting and Coating, color as indicated on Drawings.

2.5 DOOR FABRICATION

A. Minimum Gauges:
   1. Doors: 0.047 inch (1.2 mm) or 18 gauge (16 gauge for high frequency doors).
   2. 16 gauge (14 gauge for windstorm rated doors).

B. Design and Construction:
   1. Thickness shall be 1-3/4 inches (44 mm), unless specifically noted or shown otherwise.
   2. Exterior doors: Provide doors with 22 gauge steel z-channels placed at 6 inches (152 mm) apart with foamed in place polyurethane core, with a thermal insulation calculated R factor of 11.01 per ASTM C518 Standards.
   3. Fabrication:
      a. Doors shall be strong, rigid, and neat in appearance, free from warpage and buckle.
      b. Corner bends shall be true, straight, and of minimum radius for gage of metal used.
      c. Provide stiffeners with polystyrene core spaced maximum 6 inches on center and extending full height of door.
      d. Fill interior with noncombustible fiberglass insulation. Use rock mineral wool board filler as required for labeled doors.
      e. Faces shall be joined at vertical edges of door by a continuous weld extending full height of door. Welds shall be ground, filled, and dressed smooth to provide a smooth flush surface.
      f. Top and bottom edges of doors shall be closed with a continuous recessed steel channel not less than 16 gauge, extending full width of door and spot weld to both faces. Exterior doors shall have an additional flush closing channel at top and bottom edges. Openings shall be provided in the bottom closure channel at top and bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.
      g. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 08 71 00 - Door Hardware.

h. Electrical Raceways: Provide raceways for standardized plug connectors to accommodate up to 12 wires as required for electrified door hardware specified in hardware sets in Section 08 71 00 - Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
i. Doors in wet or humid areas shall have a top cap and solid foam interior core to prevent internal moisture accumulation and galvannealed.
j. Edge profile shall be provided on both vertical edges of door as follows:
1) Single-acting swing doors: Beveled 1/8 inch (3 mm) in 2 inches (51 mm) .
k. Hardware Reinforcements:
1) Doors shall be mortised, reinforced, drilled, and tapped at factory for fully template hardware, in accordance with the approved hardware schedule and templates provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only.
2) Minimum gauges for hardware reinforcing plates shall be as follows:
(a) Hinge and pivot reinforcements: 7 gauge.
(b) Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge.

4. Glass Moldings and Stops: Loose stops shall be not less than 20 gauge steel, with butt corner joints, secured to frame opening by countersunk screws. Snap-on attachments will not be acceptable.
5. Louvers: Shall be inverted "V" blade, sight-proof type, unless noted otherwise.
6. Edge Clearances:
a. Between door and frame at head and jambs: 1/8 inch (3 mm).
b. At doorsills with no threshold: 5/8 to 3/4 inch (16 to 19 mm) above finished floor.
c. At doorsills with threshold: As required to suit threshold.
d. Between meeting edges of double doors: 1/8 inch (3 mm).

C. Finish:
1. Shop paint steel (whether galvanized or ungalvanized) stops and accessories as follows:
a. Clean surfaces free of mill scale, rust, oil, grease, dirt, and other foreign matter.
b. Chemically treat surfaces and apply 1 coat of an approved baked-on rust-inhibitive primer paint to provide a minimum 0.5 mil (0.0127 mm) dry film thickness.
2. Field painted under Section 09 90 00 - Painting and Coating.

D. Thermal Insulated Door: Total insulation R-Value as indicated in Door Schedule, measured in accordance with ASTM C1363, unless otherwise noted on Drawings.

2.6 LABELED DOORS AND FRAMES

A. Labeled doors and frames shall be provided for openings requiring fire protection ratings as scheduled and to comply with NFPA 80. Such doors and frames shall be constructed as tested and approved by UL, WHI, or other nationally recognized testing agency having a factory inspection service and approved by code authorities having jurisdiction and shall bear the appropriate permanent label.

B. If any door or frame scheduled to be fire-rated cannot qualify for appropriate labeling because of its size, design, hardware, or other reason, the Architect shall be so advised before fabrication work on that item is started. Indicate and highlight on shop drawing.

PART 3 EXECUTION

3.1 COORDINATION

A. Coordinate the work of this Section.

B. Coordinate hardware installation with opening construction. Door hardware is specified in Section 08 71 00 - Door Hardware.

C. Coordinate doors, frames, and windows with glazing specified in Section 08 80 00 - Glazing.

D. Coordinate doors and frames with painting specified in Section 09 90 00 - Painting and Coating.

3.2 INSTALLATION

A. Separate dissimilar metals. Protect against galvanic action.

B. Frames:
   1. Anchorage and connections: Secure to adjacent construction. Where practical, interior door frames shall be flush with the pull side wall to minimize or eliminate the reveal and allow full 180 degree door swing.
   2. Install frames in accordance with manufacturer’s instructions and install labeled frames in accordance with NFPA 80.
   3. Frame spreader bars: Leave intact until frames are set perfectly square and plumb and anchors are securely attached.
   4. Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint work is completed. Do not remove or paint over labels on labeled frames.

C. Doors:
   1. Install hardware in accordance with hardware manufacturer's templates and instructions.
   2. Install doors in accordance with manufacturer’s instructions and install labeled doors in accordance with NFPA 80.
   3. Adjust operable parts for correct function.
   4. Remove hardware, with the exception of prime-coated items, tag, box, and reinstall after finish paint Work is completed. Do not remove or paint over labels on labeled doors.

3.3 ADJUST AND CLEAN

A. Adjust doors for proper operation, free from binding or other defects.

B. Clean and restore soiled surfaces.

C. Remove scraps and debris, and leave site in clean condition.

END OF SECTION 08 11 13

SECTION 08 13 16 - ALUMINUM DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Swing doors systems.
   2. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

A. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

B. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

C. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

D. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

E. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.

F. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.

G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

H. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

I. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

J. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

1.4 PERFORMANCE REQUIREMENTS

A. Performance: Aluminum-framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
   1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
   2. Dimensional tolerances of building frame and other adjacent construction.
   3. Failure includes the following:
      a. Deflection exceeding specified limits.
      b. Thermal stresses transferring to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
      d. Noise or vibration created by wind and by thermal and structural movements.
      e. Loosening or weakening of fasteners, attachments, and other components.
      f. Sealant failure.
      g. Failure of operating units.

B. Structural Loads: Verify with Structural Engineer

1. Wind Loads: As indicated on Drawings.

C. Deflection of Framing Members:
   1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is less.

D. Structural Test Performance: Provide aluminum framed systems tested according to ASTM E330/E330M as follows:
   1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E283/E283M at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

G. Windborne Debris Impact Resistance: Pass missile impact and cyclic pressure tests when tested according to ASTM E1886 and testing information in ASTM E1996 for Wind Zone ____.
   1. Large Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
   2. Small Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.

H. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
   2. Interior Ambient-Air Temperature: 75 degrees F (24 degrees C).

I. Condensation Resistance: Provide exterior aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

J. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F (3.23 W/sq. m x K) when tested according to AAMA 1503.

1.5 SUBMITTALS

A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.

B. Shop Drawings: Submit aluminum-framed storefront and entrance shop drawings including plans, elevations, sections, full size details, and attachments to other work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.

2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Door Hardware: Coordinate with Section 08 71 00 - Door Hardware.

D. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer having minimum 10 years documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.

B. Engineering Responsibility: Prepare data for aluminum framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance.
   1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

D. Source Limitations: Obtain aluminum-framed storefronts and entrances from single source from single manufacturer to the greatest extent possible.

E. Pre-Installation Conference: Conduct conference at site.

1.7 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.

1.8 WARRANTY

A. Warranty: Written warranty signed by Manufacturer, Contractor, and Installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Water leakage through fixed glazing and framing areas.
      d. Failure of operating components.
   2. Warranty Period: 10 years from date of Substantial Completion.

B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
   1. Warranty Period: 20 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Entrance Door Hardware:
   1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Kawneer Company, Inc: www.kawneer.us.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum: AWS D1.2/D1.2M.
      b. Sheet Steel: AWS D1.3/D1.3M.
      c. Stainless Steel: AWS D1.6/D1.6M.
      d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS

A. Basis of Design:
   1. Thermal Doors: "Insulpour 500 T" manufactured by Kawneer.
   2. Non-Thermal Doors: "500 Standard Entrance" manufactured by Kawneer.

B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B209/B209M.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
   3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
   4. Structural Profiles: ASTM B308/B308M.

C. Framing Members: Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads.
   1. Construction: Thermally broken for exterior conditions, non-thermal for interior conditions, unless noted otherwise.
   2. Glazing System: Retained mechanically with gaskets on four sides.

D. Accessories:
   1. Brackets and Reinforcements: High-strength aluminum with non-staining, non-ferrous shims for aligning system components.
   2. Fasteners and Accessories: Corrosion resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
      a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
      b. Reinforce members as required to receive fastener threads.

3. Concrete and Masonry Inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A123/A123M or ASTM A153/A153M.
4. Concealed Flashing: Corrosion resistant, non-staining, non-bleeding flashing compatible with adjacent materials.
5. Framing System Gaskets and Sealants: Recommended by manufacturer for joint type.

E. Glazing: Refer to Section 08 80 00 - Glazing.
1. Exterior Doors: Provide with insulating glazing units.
2. Interior Doors: Provide with tempered glazing.
3. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
4. Spacers and Setting Blocks: Elastomeric type.

F. Doors: Glazed doors for manual swing operation.
1. Door Construction:
   a. Thermal Doors: 2-1/4 inch (57.2 mm) overall thickness, with minimum 0.125 inch (3.2 mm) thick, extruded aluminum tubular rail and 5 inch wide stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
   b. Non-Thermal Doors: 1-3/4 inch (44.5 mm) overall thickness, with minimum 0.125 inch (3.2 mm) thick, extruded aluminum tubular rail and 5 inch wide 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; 5 inch (88.9 mm) nominal width.
3. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
4. Glazing Stops and Gaskets: Square, snap on, extruded aluminum stops and preformed gaskets.

G. Door Hardware: Refer to Section 08 71 00 - Door Hardware for door hardware sets.

H. Accessories:
1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00 - Joint Sealants.
2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) thickness per coat.

2.4 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Framing Members: Fabricate components that, when assembled, have specified 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 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 for vision glass and exterior for spandrel glazing or metal panels.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
8. Provide sill receptors with end dams at all sill conditions.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
   1. At exterior doors, provide weather stripping, sweeps, and accessible thresholds.
   2. At interior doors, provide gasketing to prevent metal to metal contact.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
   1. At pairs of exterior doors, provide compression type weather stripping retained in adjustable strip and mortised into door edge.
   2. At exterior doors, provide weather sweeps applied to door bottoms.

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.5 ALUMINUM FINISHES

A. Factory Finish: Finish to match storefront, window wall, or curtain wall system in which entry system is installed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the work. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work.
   1. Do not install damaged components.
   2. Fit joints to produce hairline joints free of burrs and distortion.
   3. Rigidly secure non-movement joints.
   4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
   5. Seal joints watertight unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Section 08 80 00 - Glazing.

G. Entrance Doors and Hardware: 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 entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum framed systems to comply with the following maximum erection tolerances:
   1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
   1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70 degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 08 13 16

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SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section includes requirements including but not limited to:
   1. WI Certified, fire-rated and non-rated, flush panel wood doors.
   2. Solid core doors with MDF and plastic laminate faces.
   3. Integration of a security system.
   4. Factory fitting flush wood doors to frames and factory machining for hardware.
   5. Accessories necessary for a complete installation.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications.
   2. Section 07 92 00 - Joint Sealants.
   3. Section 08 11 13 - Hollow Metal Doors and Frames.
   4. Section 08 80 00 - Glazing.
   5. Section 09 21 16 - Gypsum Board Assemblies.
   6. Section 09 24 00 - Cement Plastering.

1.3 REFERENCE STANDARDS

A. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

B. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

C. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

D. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

F. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.

G. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

H. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data:
   1. Technical data for each type of door indicated:
      a. Include details of core and edge construction, louvers, and trim for openings.
      b. Include factory finishing specifications.
      c. Include laboratory test report results of hinge loading, cycle/slam, stile edge screw withdrawals, and stile edge split resistance for fire rated doors.

B. Shop Drawings:
   1. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
      a. Dimensions and locations of blocking.
      b. Dimensions and locations of mortises and holes for hardware.
      c. Dimensions and locations of cutouts.
      d. Undercuts.
      e. Requirements for veneer matching.

f. Doors to be factory finished and finish requirements.
g. Fire-protection ratings for fire rated doors.

C. Certificate of Compliance for Fire Rated Doors: Provide copies of Certificate of Compliance for fire rated door assemblies and smoke and draft control door assemblies.

D. Certificate of Compliance regarding WI construction grade.

E. Certificate of Compliance regarding WI installation requirements.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Fire rated wood doors - NFPA 80 listed and labeled by UL for fire protection ratings indicated, based on testing at positive pressure according to UL 10C:
a. 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.
b. 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 degrees F (250 degrees C) above ambient after 30 minutes of standard fire-test exposure.
2. Smoke and draft control door assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
3. Accessibility requirements - comply with applicable requirements:
a. Americans with Disabilities Act of 1990, as amended:
1) ADA Title II Regulations & the 2016 ADA Standards for Accessible Design.
4. Quality standard: In addition to requirements specified, comply with Woodwork Institute WI Manual of Millwork
5. Maintain at least one copy of WI Manual for reference at jobsite throughout installation period.

B. Source Limitations: Obtain flush wood doors through one (1) source from a single manufacturer.

C. Pre-Installation Conference: Conduct conference at site.

1.6 WARRANTY

A. Warranty:
1. Written warranty signed by manufacturer, installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship. A representative of the door manufacturer shall inspect the installed doors and shall note on the warranty that no provisions of the warranty have been nullified in the manufacture and/or installation:
a. Failures include, but are not limited to, the following:
1) Warping (bow, cup, or twist) more than 1/4-inch (6.4 mm) in a 42-inch by 84-inch (1,067 mm by 2,134 mm) section.
2) Telegraphing of core construction in face veneers exceeding 0.01-inch in a three-inch (0.25 mm in a 76.2 mm) span.
b. Warranty include installation and finishing that may be required due to repair or replacement of defective doors.
c. Warranty period for solid core exterior doors: Five (5) years from date of Substantial Completion.
d. Warranty period for solid core interior doors: Life of installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect wood doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Store wood doors on a flat level surface in a dry, well ventilated, place. Keep

wood doors a minimum of 3-1/2 inches (85 mm) off floor surface and protected by a protective covering under the bottom door and over the top door. Covering should protect wood doors from dirt, water, and abuse but allow for air circulation under and around the stack. Do not store wood doors in direct sunlight. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in heavy duty cardboard cartons prior to shipment from factory. Mark each door on top and bottom rail with opening number used on shop drawings using temporary, removable, or concealed markings.

C. Handle wood doors with clean gloves. Lift and carry wood doors when moving them around the site; do not drag wood doors across one another.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Flush Wood Doors:
      a. Haley Brothers, Inc.
      b. Oshkosh Door Company.
      c. Oregon Door.
      d. Weyerhaeuser.
   2. High Pressure Laminate:
      a. Formica Corp.
      b. Panolam Surface Systems.
      c. Wilsonart LLC.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum: AWS D1.2/D1.2M.
      b. Sheet Steel: AWS D1.3/D1.3M.
      c. Stainless Steel: AWS D1.6/D1.6M.
      d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS

2.4 LIGHT FRAMES AND LOUVERS

A. Metal Frames for Light Openings: Manufacturer’s standard frame formed of 0.048 inch (1.2 mm) thick, cold-rolled steel sheet; factory primed for paint.

B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048 inch (1.2 mm) thick, cold-rolled steel sheet; factory primed for paint with baked-enamel or powder-coated finish, and approved for use in doors of fire-protection rating indicated.

C. Metal Louvers:
   1. Manufacturers are subject to compliance with requirements; provide products by one of the following:
      a. Air Louvers; a Division of the Activar Construction Products Group.

b. L & L Louvers.
c. McGill Architectural Products.

2. Blade Type: Vision-proof, inverted V.
3. Metal and finish: Hot-dip galvanized steel, 0.040 inch (1.0 mm) thick, factory primed for paint with baked-enamel or powder-coated finish.
4. Metal and finish: Extruded aluminum with Class II, clear anodic finish, AA-M12C22A31.

D. Louvers for Fire-Rated Doors - Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less:
1. Manufacturers are subject to compliance with requirements; provide products by one of the following:
a. Air Louvers; a Division of the Activar Construction Products Group.
b. L & L Louvers, Inc.
c. McGill Architectural Products.
d. Approved equal.
2. Metal and Finish: Hot-dip galvanized steel, 0.040-inch (1.0 mm) thick, factory primed for paint with baked-enamel or powder-coated finish.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated:
1. Comply with NFPA 80 requirements for fire-rated doors.

B. 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.

C. Transom and Side Panels:
1. 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:
a. 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.

D. Openings:
1. Factory cut and trim openings through doors:
a. Light openings: Trim openings with moldings of material and profile indicated.
b. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 - Glazing.
c. Louvers: Factory install louvers in prepared openings.

E. Exterior Doors:
1. Factory treat exterior doors with water repellent after fabrication has been completed but before shop priming or factory finishing:
a. Flash top of out-swinging doors with manufacturer's standard metal flashing.

PART 3 EXECUTION

3.1 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.

3.2 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.

3.3 INSTALLATION

A. Hardware: For installation, refer to Section 08 71 00 - Door Hardware.

B. Installation Instructions:
   1. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated:
      a. Install fire-rated doors according to NFPA 80.
      b. Install smoke and draft-control doors according to NFPA 105.

C. Job-Fitted Doors:
   1. 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:
      a. Clearances:
         1) Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 3/8 inch (3.2 mm) 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 (6.4 mm) from bottom of door to top of threshold unless otherwise indicated:
            (a) Comply with NFPA 80 for fire-rated doors.
      b. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
      c. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.4 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 08 14 16

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SECTION 08 31 00 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Wall- and ceiling-mounted access units.

B. Related Sections
   1. Section 04 20 00 - Unit Masonry: Placement of access frame unit anchors in masonry.
   2. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 REFERENCE STANDARDS

A. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

B. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

C. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

D. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

D. Samples: Submit two access units, 6 by 6 inches (150 by 150 mm) in size indicating frame configuration.

E. Manufacturer's Installation Instructions: Indicate installation requirements.

F. Project Record Documents: Record actual locations of each access unit.

1.5 QUALITY ASSURANCE

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Wall and/or Ceiling Access Units:
      a. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
      b. ACUDOR Products Inc: www.acudor.com.
      c. BAUCO Access Panel Solutions Inc.: www.accesspanelsolutions.com.
      d. Best Access Doors: www.bestaccessdoors.com.
      e. BILCO Company: www.bilco.com.
      f. Cendrex, Inc: www.cendrex.com.
      g. Elmdor: www.elmdor.com.
      h. FF Systems, Inc: www.ffsystemsinc.com.
      i. Karp Associates, Inc: www.karpinc.com.
      j. MIFAB, Inc: www.mifab.com.
      k. Milcor, Inc: www.milcorinc.com.
      l. Nystrom, Inc: www.nystrom.com.
      m. Studco Building Systems: www.studcosystems.com.

n. Williams Brothers Corporation of America (The): www.wbdoors.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
1. Code Standards:
a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
2. Welding Qualifications: Qualify procedures and personnel according to the following:
a. Aluminum: AWS D1.2/D1.2M.
b. Sheet Steel: AWS D1.3/D1.3M.
c. Stainless Steel: AWS D1.6/D1.6M.
d. Steel: AWS D1.1/D1.1M.

2.3 ACCESS DOOR AND PANEL ASSEMBLIES

A. General:
1. The following access panel types are for selection as required whether or not indicated on Drawings. The Contractor shall evaluate the specific requirements and provide the appropriate system based on the condition, as all types may not be required on the project. The inclusion of any of the listed access panel types does not necessarily imply that the condition exists in the scope of work.
2. Location: As indicated on Drawings or as required to access building systems.

2.4 WALL AND/OR CEILING ACCESS UNITS

A. Wall and Ceiling Units for Gypsum Board
1. Basis of Design:
a. BAUCO Plus II as manufactured by Bauco Access Panel Solutions, Inc.
2. Door: 14 gauge steel with 5/8 inch (16 mm) 5/8" recess to accommodate gypsum board panel.
3. Size: As indicated on Drawings.
4. Frame: 16 gauge steel.Casing Bead:
5. Casing Bead: 1 inch (25 mm) 1" wide, perforated 24 gauge galvanized flange.
6. Finish: Baked enamel.
a. Color: White.
7. Latch: Flush, stainless steel cam.
8. Hinged: Fully-concealed, pivot-rod hinge allowing opening to 180 degrees.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.3 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 08 31 00

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SECTION 08 33 13 - COILING COUNTER DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Electric-operated, coiling counter doors.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications.
   2. Section 06 10 00 - Rough Carpentry.
   3. Section 08 71 00 - Door Hardware.
   4. Section 09 90 00 - Painting and Coating.
   5. Division 26 - Electrical.

1.3 SUBMITTALS

A. Reference Section 01 33 00 - Submittal Procedures; submit the following items:
   1. Shop Drawings: Include special conditions not detailed in Product Data. Show interface with adjacent work.
   2. Quality Assurance/Control Submittals:
      a. Provide manufacturer ISO 9001 registration.
      b. Provide manufacturer and installer qualifications - see below.
      c. Provide manufacturer's installation instructions.
   3. Closeout Submittals:
      a. Operation and Maintenance Manual.
      b. Certificate stating that installed materials comply with this specification.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer Qualifications: ISO 9001 registered and a minimum of five years experience in producing counter doors of the type specified.
   2. Installer Qualifications: Manufacturer’s approval.

1.5 DELIVERY STORAGE AND HANDLING

A. Refer to Section 01 60 00 - Product Requirements.

B. Follow manufacturer’s instructions.

1.6 WARRANTY

A. Standard Warranty: Two years from date of shipment against defects in material and workmanship

B. Maintenance: Submit for owner’s consideration and acceptance of a maintenance service agreement for installed products.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Clopay Corporation: www.clopaydoor.com.
   2. CornellCookson, LLC.: www.cornellcookson.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
   2. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. Aluminum: AWS D1.2/D1.2M.
      b. Sheet Steel: AWS D1.3/D1.3M.
      c. Stainless Steel: AWS D1.6/D1.6M.
      d. Steel: AWS D1.1/D1.1M.

2.3 ELECTRICALLY-OPERATED COILING COUNTER DOORS

A. Basis of Design Product:
   1. Model ESC10 as manufactured by CornellCookson, LLC.

B. Curtain:
   1. Slat Configuration:
      a. Galvanized Steel with Finish No. 1F: Interlocked flat-faced slats, 1-1/2 inches (38 mm) high by 1/2 inch (13 mm) deep, minimum 22 gauge ASTM A653/A653M, Commercial Quality, galvanized steel with extruded tubular aluminum bottom bar with continuous lift handle and vinyl astragal.
   2. Finish:
      a. Stainless Steel: #4 finish.

C. Endlocks:
   1. Fabricate interlocking slat sections with high strength molded nylon endlocks riveted to ends of alternate slats

D. Guides:
   1. Fabrication:
      a. Aluminum: Heavy duty extruded aluminum sections with Snap-on cover to conceal fasteners. Provide polypropylene pile runners on both sides of curtain to eliminate metal to metal contact between guides and curtain.
   2. Finish:
      a. Material: Powder coat.
      b. Color: As selected by Architect.

E. Tube Motor Shaft Assembly:
   1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width.

F. Brackets:
   1. Fabricate from reinforced steel plate with bearings at rotating support points to support counterbalance shaft assembly and form end closures.
      a. Finish:
         1) Material: Cornell SpectraShield® Coating System.
         2) Color: As selected by Architect.

G. Hood:
   1. Minimum 24 gauge galvanized steel with reinforced top and bottom edges. Provide minimum 1/4 inch (6.35 mm) steel intermediate support brackets.
      a. Finish:
         1) Material: Cornell SpectraShield® Coating System.

2) Color: As selected by Architect.

2.4 OPERATION

A. Electric Tube Motor Operator:
   1. Rated for a maximum of 10 cycles per day, cULus recognized, rated (50 nm) (100 nm) or (200 nm) as recommended by door manufacturer for size and type of door, 110 Volts, 1 Phase.
   2. Provide complete with electric tube motor, maintenance free electric brake, emergency manual crank hoist and control station(s). Motor shall be protected against overload with an auto-reset thermal sensing device.
   3. Operator shall be equipped with an emergency manual crank hoist assembly that safely cuts operator power when engaged. A disconnect chain shall not be required to engage or release the manual crank hoist.
   4. Operator shall be capable of 10-14 RPM. Fully adjustable, mechanical internal worm limit switch mechanism shall synchronize the operator with the door.
   5. Electrical Contractor shall mount the control station(s) and supply the appropriate disconnect switch, all conduit and wiring per the overhead door wiring instructions.

B. Control Station: For use with motor operated units only.
   1. Flush mounted: "Open/Close" key switch with BEST cylinder.

C. Control Operation:
   1. Constant pressure to close:
      a. 2-wire, electric sensing edge seal extending full width of door bottom bar. Contact before door fully closes shall cause door to immediately stop downward travel and reverse direction to the fully opened position. Provide a wireless edge connection to control circuit.

2.5 ACCESSORIES

A. Locking:
   1. Master Key Cylinder Lock to Owner Standards:
      a. Operable from coil side of bottom bar. Provide Interlock switches on motor operated units.
      b. BEST 7-Pin.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings.

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

A. Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports.

B. Follow manufacturer's installation instructions.

3.3 ADJUSTING

A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion.

3.4 CLEANING

A. Clean surfaces soiled by work as recommended by manufacturer.

B. Remove surplus materials and debris from the site.

3.5 DEMONSTRATION

A. Demonstrate proper operation to Owner's Designated Representative (ODR).

B. Instruct Owner's Designated Representative (ODR) in maintenance procedures.

END OF SECTION 08 33 13

SECTION 08 33 26 - OVERHEAD COILING GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Open curtain overhead coiling grilles.
   2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical data for each type and size of overhead coiling grille and accessory, including construction details, material descriptions, dimensions of individual components, profiles for curtain components, and finishes.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: Submit for each installation and for special components not dimensioned or detailed in manufacturer's product data, plans, elevations, sections, and mounting details.
   1. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   3. For exterior components, include details of provisions for assembly expansion and contraction.
   4. Show locations of controls, locking devices, and other accessories.
   5. Include diagrams for power, signal, and control wiring.

C. Samples: Submit samples for each type of exposed finish on the following components, in standard sizes:
   1. Open curtain grille with full size components consisting of rods, spacers, and links as required to illustrate each assembly.
   2. Bottom bar with sensor edge.
   3. Guides.
   4. Mounting frame.
   5. Brackets.
   6. Hood.

D. Maintenance Data: Submit for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Installer Qualifications: Entity having minimum 5 years documented experience, employing installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required.

C. Source Limitations: Obtain overhead coiling grilles from single source from single manufacturer.
1. Obtain operators and controls from overhead coiling-grille manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design: Cookson Company. Other manufacturers are subject to compliance with requirements. Other approved manufacturers:
1. Cornell Iron Works, Inc.
2. McKeon Rolling Steel Door Company, Inc.
3. Overhead Door Corporation.

B. Open Curtain Grille: Overhead coiling grille with curtain having a network of horizontal rods that interconnect with vertical links.

C. Operation Cycles: Grille components and operators capable of operating for not less than 100,000. One operation cycle is complete when a grille is opened from the closed position to the fully open position and returned to the closed position.

D. Grille Curtain Material: Aluminum.
1. Rod Spacing: Approximately 2 inches (51 mm) o.c.
2. Link Spacing: Approximately 3 inches (76 mm) apart in a straight pattern.
3. Spacers: Metal tubes matching curtain material.

E. Bottom Bar: Continuous tubular shape, fabricated from aluminum extrusion and finished to match grille.

F. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal to metal contact and to minimize operational noise.

G. Hood: Match curtain material and finish.
1. Shape: Round.
2. Mounting: Face of wall.

H. Locking Devices: Equip grille with locking device assembly.
1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside with thumb turn and outside with key.
2. Ensure key is compatible with the building's master keying system specified in Section 08 71 00 Door Hardware.

I. Manual Grille Operator: Chain hoist operator
1. Provide operator with through wall shaft operation.

J. Curtain Accessories: Equip grille with push/pull handles.

K. Grille Finish:

1. Aluminum Finish: Anodized clear.

2.2 FABRICATION

A. Open Curtain Grilles: Fabricate metal grille curtain as an open network of horizontal rods, spaced at regular intervals, that are interconnected with vertical links, which are formed and spaced as indicated and are free to rotate on the rods.
   1. Aluminum Grille Curtain: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Bottom Bar: Continuous shape unless otherwise indicated, finished to match grille.

C. Grille Curtain Jamb Guides: Shape having curtain groove with return lips or bars to retain curtain. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise; with removable stops on guides to prevent overtravel of curtain.
   1. Removable Posts and Jamb Guides: Standard.

D. Hood and Accessories: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. 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. Aluminum: 0.040 inch (1.02 mm) thick aluminum sheet, complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
   2. Mounting Frame: Manufacturer's standard mounting frame designed to support grille; factory fabricated from ASTM A 36/A 36M structural steel shapes, hot dip galvanized per ASTM A 123/A 123M; fastened to floor and structure above grille; to be built into wall construction; and complete with anchors, connections, and fasteners.
   3. Push/Pull Handles: Equip push-up-operated or emergency-operated grille with lifting handles on each side of grille, finished to match grille.

E. Locking Device Assembly: Fabricate with cylinder lock, spring loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
   1. Lock Cylinders: Cylinders specified in Section 08 71 00.
   2. Keys: Five for each cylinder.
   3. Install a key switch on both sides of overhead coiling grilles.

F. Safety Interlock Switch: Equip power-operated grilles with safety interlock switch to disengage power supply when grille is locked.

G. Counterbalance Mechanism: Counterbalance grilles by using 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.
   1. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot formed, structural quality, seamless carbon steel pipe, of sufficient diameter and wall thickness to support rolled up curtain without distortion of parts and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
   2. Counterbalance Spring: 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.
   3. Torsion Rod for Counterbalance Shaft: Fabricate of cold rolled steel, sized to hold fixed spring ends and carry torsional load.
   4. Brackets: Mounting brackets of either cast iron or cold rolled steel plate.

2.3 ELECTRIC GRILLE OPERATORS

A. Electric grille operator assembly of size and capacity recommended and provided by grille manufacturer for grille and operation cycles requirement specified, with electric motor and factory prewired motor controls, starter, gear reduction unit, solenoid operated brake, clutch, control stations, control devices, integral gearing for locking grille, and accessories required for proper operation.
   1. Comply with NFPA 70.
   2. 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.
   3. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each grille.
   4. Grille Operator Location(s): Operator location indicated for each grille.
      a. Front of Hood Mounted: Operator is mounted to the right or left grille head plate, with the operator on coil side of the grille hood assembly and connected to the grille drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

   5. Motors: Reversible type motor for motor exposure indicated.
      a. Electrical Characteristics:
         1) Phase: Polyphase.
         2) Volts: 115 V.
         3) Hertz: 60.

      b. Motor Size: Sized large enough to start, accelerate, and operate grille in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
      c. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
      d. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

   6. Limit Switches: Equip motorized grille with adjustable switches interlocked with motor controls and set to automatically stop grille at fully opened and fully closed positions.
   7. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of grille opening. Activation of sensor immediately stops and reverses downward grille travel.
      a. Electric 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 take up reel or self coiling cable.
         1) Self Monitoring Type: Four-wire configured device designed to interface with grille operator control circuit to detect damage to or disconnection of sensor edge.
   8. Control Station: Three button control station in fixed location with momentary contact push button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
      a. Interior Mounted Units: Full guarded, surface mounted, heavy duty type, with general purpose NEMA ICS 6, Type 1 enclosure.
   9. Emergency Manual Operation: Equip electrically powered grille with capability for emergency manual operation. Design manual mechanism so required force for grille operation does not exceed 25 lbf (111 N).
   10. 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.

11. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.4 FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA *Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)* 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.

C. Aluminum Finish:
1. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for substrate construction and other conditions affecting performance of the Work. Examine locations of electrical connections.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Install overhead coiling grilles 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 grilles, hoods, controls, and operators at the mounting locations indicated for each grille.

C. Accessibility: Install overhead coiling grilles, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power Operated Grilles: Install automatic grille openers according to UL 325.

3.3 STARTUP SERVICE

A. Perform installation and startup checks according to manufacturer's written instructions.

B. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Test grille opening when activated by detector, fire-alarm system, emergency-egress release, or self-opening mechanism as required. Reset grille-opening mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly, so that grilles operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling grille Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for grille operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   1. Perform maintenance, including emergency callback service, during normal working hours.

3.6 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling grilles.

END OF SECTION 08 33 26

SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section includes requirements including but not limited to:
   1. Exterior and interior storefront framing.
   2. Exterior and interior manual swing entrance doors.
   3. Accessories necessary for a complete installation.

B. Related Sections:
   1. Section 05 12 00 - Structural Steel Framing.
   2. Section 05 40 00 - Cold Formed Metal Framing.
   3. Section 05 50 00 - Metal Fabrications.
   4. Section 07 62 00 - Roof Related Sheet Metal.
   5. Section 07 92 00 - Joint Sealants.
   6. Section 08 13 16 - Aluminum Doors.

1.3 REFERENCE STANDARDS

A. 2012 TAS - Texas Accessibility Standards; 2012.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.

D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

J. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.

K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

M. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

N. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

O. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.

P. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.

Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

R. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

S. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

T. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

1.4 SUBMITTALS

A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.

B. Shop Drawings:
   1. Submit aluminum storefront framing and entrances shop drawings including plans, elevations, sections, full size details, and attachments to other work:
      a. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
      b. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

D. Engineer’s calculations of performance requirements.

E. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

1.5 PERFORMANCE REQUIREMENTS

A. Aluminum framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or fail due to defective manufacture, fabrication, installation, or other defects in construction:
   1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
   2. Dimensional tolerances of building frame and other adjacent construction.
   3. Failure includes the following:
      a. Deflection exceeding specified limits.
      b. Thermal stresses transferring to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
      d. Noise or vibration created by wind and by thermal and structural movements.
      e. Loosening or weakening of fasteners, attachments, and other components.
      f. Sealant failure.
      g. Failure of operating units.

B. Structural Loads:
   1. Wind loads: _____ Ultimate wind speed gust 115 mph; exposure D.

C. Deflection of Framing Members:

1. Deflection normal to wall plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection parallel to glazing plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

D. Structural Test Performance - Provide aluminum framed systems tested according to ASTM E330/E330M as follows:
1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test durations: As required by design wind velocity, but not fewer than 10 seconds.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E331 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

G. Windborne Debris Impact Resistance:
1. Pass missile impact and cyclic pressure tests when tested according to ASTM E1886 and testing information in ASTM E1996 for Wind Zone 2:
a. Large missile test: For glazed openings located within 30 feet (9.1 m) of grade.

H. Thermal Movements:
1. Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss:
a. Temperature change (range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
b. Interior ambient-air temperature: 75 degrees F (24 degrees C).

I. Condensation Resistance: Provide aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

J. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F (3.23 W/sq. m x K) when tested according to AAMA 1503.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Accessibility requirements:
a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.

B. Installer Qualifications: Installer having minimum 10 years' documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.

C. Engineering Responsibility: Prepare data for aluminum framed systems, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.

D. Product Options:
   1. Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance:
      a. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Source Limitations: Obtain aluminum framed entrances from single source from single manufacturer.

F. Pre-Installation Conference: Conduct conference at site.

1.7 WARRANTY

A. Written warranty signed by manufacturer, Contractor, and installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Water leakage through fixed glazing and framing areas.
      d. Failure of operating components.
   2. Warranty period: 2 years from date of Substantial Completion.

B. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering:
   1. Warranty period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MATERIALS

A. Manufactureres:
   1. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
      a. Kawneer: www.kawneer.us.
      b. Oldcastle BuildingEnvelope: www.obe.com.
      c. Tubelite, Inc.: www.tubeliteusa.com.
      d. US Aluminum Corporation: www.usalum.com.
      e. YKK America AP, Inc.: www.ykkap.com.
   2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
      a. Manufacturers and fabricators not listed must have a minimum of 5 years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:

a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2. Welding Qualifications: Qualify procedures and personnel according to the following:
   a. Aluminum: AWS D1.2/D1.2M.
   b. Sheet Steel: AWS D1.3/D1.3M.
   c. Stainless Steel: AWS D1.6/D1.6M.
   d. Steel: AWS D1.1/D1.1M.

2.3 ALUMINUM-FRAMED STOREFRONT SYSTEMS

A. Basis of Design:
   1. Standard Systems:
      a. Trifab VersaGlaze 451 and 451T manufactured by Kawneer.
   2. Impact Resistant Systems:
      a. Trifab 601 and 601T manufactured by Kawneer.

B. General:
   1. Maximum design pressure +/- 45 psf.
   2. Refer to Drawings for frame size and locations. Subject to compliance with requirements, provide comparable storefront system by one of the following:

C. Aluminum:
   1. Alloy and temper recommended by manufacturer for type of use and finish indicated:
      a. Sheet and plate: ASTM B209/B209M.
      b. Extruded bars, rods, profiles, and tubes: ASTM B221/ASTM B221M.
      c. Extruded structural pipe and tubes: ASTM B429/B429M.

D. Framing Members:
   1. Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads:
      a. Construction: Non-Thermal or Thermal, as indicated on Drawings.
      b. Glazing system: Retained mechanically with gaskets on four sides.
      c. Glazing Plane: Front.

E. Accessories:
   1. Brackets and reinforcements: High strength aluminum with nonstaining, nonferrous shims for aligning system components.
   2. Fasteners and accessories:
      a. Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials:
         1) Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
         2) Reinforce members as required to receive fastener threads.
   3. Concrete and masonry inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A123/A123M or ASTM A153/A153M.
   4. Concealed flashing: Corrosion resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
   5. Framing system gaskets and sealants: Recommended by manufacturer for joint type.

F. Glazing:
   1. Refer to Section 08 80 00 - Glazing for impact resistant laminated insulating glaxing units
   2. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
   3. Spacers and Setting Blocks: Elastomeric type.

G. Entrance Doors:
   1. Refer to Section 08 13 16 - Aluminum Doors.

H. Accessories:
1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00 - Joint Sealants.
2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) 30 mil (0.762 mm) thickness per coat.
3. Sunshade Outrigger System:
a. Basis of Design: Versoleil as manufactured by Kawneer.
b. Depth: 30 inches.

2.4 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Framing Members:
1. Fabricate components that, when assembled, have specified characteristics:
a. Profiles that are sharp, straight, and free of defects or deformations.
b. Accurately fitted joints with ends coped or mitered.
c. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
d. Physical and thermal isolation of glazing from framing members.
e. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
f. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
g. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
h. Provide sill receptors with end dams at all sill conditions.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

D. Storefront Framing: Fabricate components for assembly using screw spline system.

E. Entrance Door Frames:
1. Reinforce as required to support loads imposed by door operation and for installing entrance door hardware:
a. At exterior doors, provide weather stripping at fixed stops.
b. At interior doors, provide weather stripping at stops to prevent metal to metal contact.

F. After fabrication, clearly mark components to identify their locations in Project according to shop drawings.

2.5 ALUMINUM FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

B. Color: As indicated on Drawings.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum framed systems by field measurements before fabrication and indicate measurements on shop drawings.

3.2 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the work. Proceed with installation after correcting unsatisfactory conditions.

3.3 INSTALLATION

A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work:
   1. Do not install damaged components.
   2. Fit joints to produce hairline joints free of burrs and distortion.
   3. Rigidly secure nonmovement joints.
   4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
   5. Seal joints watertight unless otherwise indicated.
   6. Min anchorage #8 with 2 inch minimum embedment; minimum 2 inches from edges. Refer to shop drawings.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing specified in Section 08 80 00 - Glazing.

G. Entrance Doors and Hardware:
   1. Install doors to produce smooth operation and tight fit at contact points:
      a. Exterior doors: Install to produce weathertight enclosure and tight fit at weather stripping.
      b. Field installed entrance door hardware: Install surface mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.

3.4 TOLERANCES

A. Install aluminum framed systems to comply with the following maximum erection tolerances:
   1. Location and plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.5 FIELD QUALITY CONTROL

A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.

B. Refer to Section 01 40 00 - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

C. Refer to Section 01 40 00 - Quality Requirements for general testing and inspection requirements.

D. Water-Spray Test: Provide water spray quality test of installed curtain wall components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

E. Provide field testing of installed curtain wall system by AAMA accredited independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
   1. Timing of Testing:
      a. Test curtain wall prior to installation of exterior cladding.
   2. Preparation for Testing:
      a. Ensure that flashings are installed and not damaged. Repair or replace any that have been damaged.
      b. Verify that sealants are installed and fully cured.
   3. Perform a minimum of two tests in each designated area as indicated on drawings.
   4. Conduct tests in each area prior to 10 percent, 50 percent, and 75 percent completion of this work.
   5. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 6.24 psf (299 Pa).
      a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce (14 gram) that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
   6. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf (75 Pa).
      a. Maximum allowable rate of air leakage is 0.09 cfm/sq ft (0.5 L/s sq m).

F. Failure of Testing:
   1. Repair or replace curtain wall components that have failed designated field testing.
   2. Retest failed curtain wall plus one additional to verify performance complies with specified requirements.

3.6 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer:
   1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3 second closer sweep period for doors to move from a 70 degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 08 43 13

SECTION 08 71 00 DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood and hollow metal doors.

B. Thresholds.

C. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

A. Section 081113 - Hollow Metal Doors and Frames.

B. Section 081116 - Aluminum Doors and Frames.

C. Section 081213 - Hollow Metal Frames.

D. Section 081416 - Flush Wood Doors.

E. Section 081433 - Stile and Rail Wood Doors.

F. Section 084313 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

C. BHMA A156.1 - Standard for Butts and Hinges; 2021.

D. BHMA A156.2 - Bored and Preassembled Locks and Latches; 2022.

E. BHMA A156.3 - Exit Devices; 2020.

F. BHMA A156.4 - Door Controls - Closers; 2019.

G. BHMA A156.5 - Cylinders and Input Devices for Locks; 2020.

H. BHMA A156.6 - Standard for Architectural Door Trim; 2021.

I. BHMA A156.7 - Template Hinge Dimensions; 2016.

J. BHMA A156.16 - Auxiliary Hardware; 2018.

K. BHMA A156.21 - Thresholds; 2019.

L. BHMA A156.22 - Standard for Gasketing; 2021.

M. BHMA A156.26 - Standard for Continuous Hinges; 2021.

N. BHMA A156.28 - Standard for Recommended Practices for Mechanical Keying Systems; 2018.

O. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2016.

P. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.

Q. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.

R. DHI (KSN) - Keying Systems and Nomenclature; 2019.

S. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.

T. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.

U. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

V. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

W. ITS (DIR) - Directory of Listed Products; Current Edition.

X. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

Y. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.

Z. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

AA. UL (DIR) - Online Certifications Directory; Current Edition.

BB. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

CC. UL 437 - Standard for Key Locks; Current Edition, Including All Revisions.

DD. UL 1037 - Antitheft Alarms and Devices; Current Edition, Including All Revisions.

EE. UL 1610 - Central-Station Burglar-Alarm Units; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Sequence installation to ensure facility services connections are achieved in an orderly and expeditious manner.

C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by affected installers and the following:
   1. Architect.
   2. Installer's Architectural Hardware Consultant (AHC).
   3. Hardware Installer.
   4. Owner's Security Consultant.

D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

E. Keying Requirements Meeting:
   1. Schedule meeting at project site prior to Contractor occupancy.
   2. Attendance Required:
      a. Contractor.
      b. Owner.
      c. Door Hardware Installer.
      d. Owner's Security Consultant.
   3. Agenda:
      a. Establish keying requirements.
      b. Verify locksets and locking hardware are functionally correct for project requirements.
      c. Verify that keying and programming complies with project requirements.
      d. Establish keying submittal schedule and update requirements.
   4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
      a. Key control system requirements.
   5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
   6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: A detailed listing that includes each item of hardware to be installed on each door.
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).

2. Comply with DHI (H&S) using door numbering scheme and hardware set numbers as indicated in Contract Documents.
   a. Submit in vertical format.
3. Include complete description for each door listed.

D. Shop Drawings - Electrified Door Hardware: Include diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
2. Elevations: Include front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
3. Diagrams: Include point-to-point wiring diagrams that show each device in door opening system with related colored wire connections to each device.

E. Samples for Verification:
1. Submit minimum size of 2 by 4 inch (51 by 102 mm) for sheet samples, and minimum length of 4 inch (102 mm) for other products.
2. Submit one (1) sample of hinge, lockset, and closer illustrating style, color, and finish.
3. Include product description with samples.

F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

I. Supplier's qualification statement.

J. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

K. Keying Schedule:
1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

L. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

M. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

N. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

D. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) to assist in work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.
   1. Closers: Five years, minimum.
   2. Exit Devices: Three years, minimum.
   3. Locksets and Cylinders: Three years, minimum.
   4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Closers:
   1. Provide door closer on each exterior door, unless otherwise indicated.
   2. Provide door closer on each fire-rated and smoke-rated door.
   3. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.

D. Drip Guards: Provide at head of outswinging exterior doors unless protected by roof or canopy directly overhead.

E. Weatherstripping and Gasketing:

F. Fasteners:
   1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
      a. Aluminum fasteners are not permitted.
      b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
   2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
      a. Self-drilling (Tek) type screws are not permitted.
   3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
   4. Provide wall grip inserts for hollow wall construction.
   5. Fire-Resistance-Rated Applications: Comply with NFPA 80.
      a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
      b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.02 PERFORMANCE REQUIREMENTS

A. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes.
   2. Accessibility: ADA Standards and ICC A117.1.
   3. Fire-Resistance-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
   4. Hardware on Fire-Resistance-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
   5. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
   6. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.

7. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

2.03 HINGES

A. Manufacturers: Conventional butt hinges.
   1. BEST; dormakaba Group: www.bestaccess.com/#sle.
   2. Hager; Hager Companies: https://www.hagerco.com/home.
   3. McKinney; Assa Abloy: https://www.mckinneyhinge.com/en.
   4. Ives; Allegion PLC: https://us.allegion.com/en/products/brands/ives.html
   5. Substitutions: Not permitted.

B. Properties:
   1. Butt Hinges: As applicable to each item specified.
      a. Standard Weight Hinges: Minimum of two (2) permanently lubricated non-detachable bearings.
      b. Heavy Weight Hinges: Minimum of four (4) permanently lubricated bearings on heavy weight hinges.
      c. Template screw hole locations.
      d. Bearing assembly installed after plating.
      e. Bearings: Exposed fully hardened bearings.
      f. Bearing Shells: Shapes consistent with barrels.
      g. Pins: Easily seated, non-rising pins.
         1) Fully plate hinge pins.
         2) Non-Removable Pins: Slotted stainless steel screws.
      h. UL 10C listed for fire-resistance-rated doors.
   2. Continuous Hinges: As applicable to each item specified.
      a. Geared Continuous Hinges: As applicable to each item specified.
         1) Non-handed.
         2) Anti-spinning through-fastener.
         3) UL 10C listed for fire-resistance-rated doors.
            (a) Metal Door Installation: Rated up to 90 minutes.
            (b) Wood Door Installation: Rated up to 60 minutes.
         4) Sufficient size to permit door to swing 180 degrees

C. Sizes: See Door Hardware Schedule.
   1. Hinge Widths: As required to clear surrounding trim.
   2. Sufficient size to allow 180 degree swing of door.

D. Finishes: See Door Hardware Schedule.
   1. Fully polish hinges; front, back, and barrel.

E. Grades:
   1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
   2. Continuous Hinges: Comply with BHMA A156.26, Grade 1.

F. Material: Base metal as indicated for each item by BHMA material and finish designation.

G. Types:
   1. Butt Hinges: Include full mortise hinges.
   2. Continuous Hinges: Include geared hinges.

H. Quantities:
   1. Butt Hinges: Three (3) hinges per leaves up to 90 inches (2286 mm) in height. Add one (1) for each additional 30 inches (762 mm) in height or fraction thereof.
      a. Hinge weight and size unless otherwise indicated in hardware sets:
         1) For doors up to 36 inches (914 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.134 inch (3.4 mm) and a minimum of 4-1/2 inches (114 mm) in height.

2) For doors from 36 inches (914 mm) wide up to 42 inches (1067 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.145 inch (3.7 mm) and a minimum of 4-1/2 inches (114 mm) in height.
3) For doors from 42 inches (1067 mm) wide up to 48 inches (1219 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.
4) For doors greater than 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.

2. Continuous Hinges: One per door leaf.

I. Applications: At swinging doors.
1. Provide non-removable pins at out-swinging doors with locking hardware and all exterior doors.

J. Products:
1. Butt Hinges:
a. Ball Bearing, Five (5) Knuckle.
2. Continuous Hinges:
a. Aluminum geared hinges.

2.04 BOLTS

A. Manufacturers:
1. Trimco: www.trimcohardware.com/#sle.
2. Ives; Allegion PLC: https://us.allegion.com/en/products/brands/ives.html.
3. Rockwood; Assa Abloy: https://www.rockwoodmfg.com/en.
4. Substitutions: See Section 016000 - Product Requirements.

B. Properties:
1. Flush Bolts:
a. Automatic Flush Bolts: Automatically latching upon closing of door leaf.
1) Bolt Throw: 3/4 inch (19 mm), minimum.
2. Dustproof Strikes: For bolting into floor, provide except at metal thresholds.

C. Options:
1. Lever extensions: Provide for top bolt at oversized doors.

D. Products:
1. Automatic flush bolts.

2.05 EXIT DEVICES

A. Manufacturers:
1. BEST, dormakaba Group: www.bestaccess.com/#sle.Corbin Russwin; Assa Abloy: https://www.corbinrusswin.com/
2. Von Duprin; Allegion PLC:https://www.vonduprin.com/en/index.html.
3. Substitutions: See Section 016000 - Product Requirements.

B. Properties:
1. Actuation: Full-length touchpad.
2. Touchpads: 'T" style metal touchpads and rail assemblies with matching chassis covers end caps.
3. Latch Bolts: Stainless steel deadlocking with 3/4 inch (19 mm) projection using latch bolt.
4. Lever Design: Match project standard lockset trims.
5. Cylinder: Include where cylinder dogging or locking trim is indicated.
6. Strike as recommended by manufacturer for application indicated.
7. Sound dampening on touch bar.
8. Dogging:
a. Non-Fire-Resistance-Rated Devices: Cylinder 1/4 inch (6 mm).

b. Fire-Resistance-Rated Devices: Manual dogging not permitted.
9. Touch bar assembly on wide style exit devices to have a 1/4 inch (6.3 mm) clearance to allow for vision frames.
10. All exposed exit device components to be of architectural metals and “true” architectural finishes.
11. Handing: Field-reversible.
12. Fasteners on Back Side of Device Channel: Concealed - exposed fasteners not allowed.
13. Vertical Latch Assemblies' Operation: Gravity, without use of springs.

C. Grades: Complying with BHMA A156.3, Grade 1.
1. Provide exit devices tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.

2.06 LOCK CYLINDERS

A. Manufacturers:
1. BEST, dormakaba Group: www.bestaccess.com/#sle.
2. Substitutions: Not permitted.

B. Properties:
1. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
a. Provide cylinders from same manufacturer as locking device.
b. Provide cams and/or tailpieces as required for locking devices.
c. Provide cylinders with appropriate format interchangeable cores where indicated.

C. Grades:
1. Standard Security Cylinders: Comply with BHMA A156.5.

D. Material:

E. Types: As applicable to each item specified.
1. Standard security small format interchangeable core (SFIC) type cylinders, with seven-pin, 1CM-7 cores.

F. Applications: At locations indicated in hardware sets, and as follows
1. As required for items with locking devices provided by other sections, including at elevator controls and cabinets.
a. When provisions for lock cylinders are referenced elsewhere in the Project Manual to this Section, provide compatible type of lock cylinder, keyed to building keying system, unless otherwise indicated.

G. Products:
1. Rim/mortise.

2.07 MORTISE LOCKS

A. Manufacturers:
1. BEST, dormakaba Group: www.bestaccess.com/#sle.
2. Substitutions: Not permitted.

B. Properties:
1. Mechanical Locks: Manufacturer's standard.
a. Fitting modified ANSI A115.1 door preparation.
b. Door Thickness Coordination Fitting 1-3/4 inch (44 mm) to 2-1/4 inch (57 mm) thick doors.
c. Latch: Solid, one-piece, anti-friction, self-lubricating stainless steel.
1) Latchbolt Throw: 3/4 inch (19 mm), minimum.
d. Auxiliary Deadlatch: One piece stainless steel, permanently lubricated.
e. Backset: 2-3/4 inch (70 mm).
f. Lever Trim:

1) Functionality: Allow the lever handle to move up to 45 degrees from horizontal position prior to engaging the latchbolt assembly.
2) Strength: Locksets outside locked lever designed to withstand minimum 1,400 inch-lbs (158.2 Nm) of torque. In excess of that, a replaceable part will shear. Key from outside and/or inside lever will still operate lockset.
3) Spindle: Designed to prevent forced entry from attacking of lever.
4) Independent spring mechanism for each lever.
   (a) Trim to be self-aligning and thru-bolted.
5) Handles: Made of forged or cast brass, bronze, or stainless steel construction. Levers that contain a hollow cavity are not acceptable.
6) Levers to operate a roller bearing spindle hub mechanism.

C. Finishes: See Door Hardware Schedule.
   1. Core Faces: Match finish of lockset.

D. Grades:

E. Options:
   1. Provide locksets made in a manufacturing facility to compliant with ISO 9001-Quality Management and ISO 14001-Environmental Management.

F. Products: Mortise locks, including standard and electrified types.
   1. 40H.

2.08 CYLINDRICAL LOCKS

A. Manufacturers:
   1. BEST, dormakaba Group: www.bestaccess.com/#sle.
   2. Substitutions: Not permitted.

B. Properties:
   1. Mechanical Locks:
      a. Fitting modified ANSI A115.2 door preparation.
      b. Door Thickness Fit: 1-3/8 inches (35 mm) to 2-1/4 inches (57 mm) thick doors.
      c. Construction: Hub, side plate, shrouded rose, locking pin to be a one-piece casting with a shrouded locking lug.
         1) Through-bolted anti-rotational studs.
      d. Cast stainless steel latch retractor with roller bearings for exceptionally smooth operation and superior strength and durability.
      e. Bored Hole: 2-1/8 inch (54 mm) diameter.
      f. Backset: 2-3/4 inches (70 mm) unless otherwise indicated.
      g. Latch: Single piece tail-piece construction.
         1) Latchbolt Throw: 9/16 inch (14.3 mm), minimum.
      h. Cylinders:
         1) Cylinder Core Types: Locks capable of supporting manufacturers' cores, as applicable.
            (a) Small format interchangeable.
      i. Lever Trim:
         1) Style: See Door Hardware Schedule.
         2) Functionality: Allow the lever handle to move up to 45 degrees from horizontal position prior to engaging the latchbolt assembly.
         3) Strength: Locksets outside locked lever designed to withstand minimum1,400 inch-lbs (158.2 Nm) of torque. In excess of that, a replaceable part will shear. Key from outside and/or inside lever will still operate lockset.
         4) Independent spring mechanism for each lever.
            (a) Contain lever springs in the main lock hub.
         5) Outside Lever Sleeve: Seamless one-piece construction.
         6) Keyed Levers: Removable only after core is removed by authorized control key.

C. Finishes: See Door Hardware Schedule.
   1. Core Faces: Match finish of lockset.

D. Grades: Comply with BHMA A156.2, Grade 1, Series 4000, Operational Grade 1, Extra Heavy Duty.
   1. Durability: Passing 50 Million cycle tests verified by third party testing agency.

E. Material: Manufacturer's stadard for specified lock.
   1. Critical Latch and Chassis Components: Brass or corrosion-resistance treated steel.
   2. Outside Lever Sleeve: Hardened steel alloy.

F. Options:

G. Products: Cylindrical locks, including mechanical and electrified types.
   1. 9K (Grade 1).

2.09 DOOR PULLS AND PUSH PLATES

A. Manufacturers:
   1. Trimco: www.trimcohardware.com/#sle.
   2. Ives; Allegion PLC: https://us.allegion.com/en/products/brands/ives.html.
   3. Rockwood; Assa Abloy: https://www.rockwoodmfg.com/en.
   4. Substitutions: Not permitted.

B. Properties:
   1. Pull Type: Straight, unless otherwise indicated.
   2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
      a. Edges: Beveled, unless otherwise indicated.

C. Grades: Comply with BHMA A156.6.

D. Material: Stainless steel, unless otherwise indicated.

E. Products:
   1. Push-Pull Plates.

2.10 COORDINATORS

A. Manufacturers:
   1. Ives; Allegion PLC: https://us.allegion.com/en/products/brands/ives.html
   2. Rockwood; Assa Abloy: https://www.rockwoodmfg.com/en.
   3. Substitutions: Not permitted.

B. Properties:
   1. General: Non-handed devices, with field-selectable active door leaf.

C. Grades:

D. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.
   1. Meet UL 10C for Positive Pressure.

E. Types:

F. Installation:
   1. Mounting: Provide necessary mounting brackets and filler bars to ensure proper installation of coordinator and related hardware.
   2. Coordination: Properly sequence installation of other door hardware affected by placement of coordinators and carry bars.

2.11 CLOSERS

A. Manufacturers:
   1. BEST, dormakaba Group: www.bestaccess.com/#sle.
   2. dormakaba, dormakaba Group: https://www.dormakaba.com/
   3. Sargent; Assa Abloy: https://www.sargentlock.com

4. LCN; Allegion PLC: https://www.lcnclosers.com/en/index.html.
5. Substitutions: Not permitted.

B. Properties:

C. Grades:
1. Closers: Comply with BHMA A156.4, Grade 1.
a. Underwriters Laboratories Compliance:
1) Product Listing: UL (DIR) and ULC for use on fire-resistance-rated doors.
(a) UL 228 - Door Closers-Holders, With or Without Integral Smoke Detectors.

D. Types:
1. Rack-and-pinion, surface-mounted. 1-1/2 inches (38 mm) minimum bore.

E. Options:
1. Advanced backcheck.

F. Installation:
1. Mounting: Includes surface mounted installations.
2. Mount closers on non-public side of door and stair side of stair doors unless otherwise noted in hardware sets.
3. At outswinging exterior doors, mount closer on interior side of door.
4. Provide adapter plates, shim spacers, and blade stop spacers as required by frame and door conditions.
5. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

2.12 PROTECTION PLATES

A. Manufacturers:
1. Ives; Allegion PLC: https://us.allegion.com/en/products/brands/ives.html.
2. Rockwood; Assa Abloy: https://www.rockwoodmfg.com/en.
3. Substitutions: Not permitted.

B. Properties:
1. Plates:
a. Kick Plates: Provide along bottom edge of push side of every wood door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
b. Edges: Beveled, on four (4) unless otherwise indicated.

C. Grades: Comply with BHMA A156.6.

D. Material: As indicated for each item by BHMA material and finish designation.
1. Metal Properties: Stainless steel.

E. Installation:
1. Fasteners: Countersunk screw fasteners

2.13 STOPS AND HOLDERS

A. Manufacturers:
1. Trimco: www.trimcohardware.com/#sle.
2. Rockwood; Assa Abloy: https://www.rockwoodmfg.com/en.
3. Ives; Allegion PLC: https://us.allegion.com/en/products/brands/ives.html.
4. Substitutions: Not permitted.

B. General: Provide overhead stop/holder when wall or floor stop is not feasible.

C. Grades:
1. Door Holders, Wall Bumpers, and Floor Stops: Comply with BHMA A156.16 and Resilient Material Retention Test as described in this standard.

D. Material: Base metal as indicated for each item by BHMA material and finish designation.

E. Types:

1. Wall Bumpers: Bumper, concave, wall stop.
2. Floor Stops: Provide with bumper floor stop.

F. Installation:
1. Non-Masonry Walls: Confirm adequate wall reinforcement has been installed to allow lasting installation of wall bumpers.

G. Products:
1. Wall Bumpers.
2. Floor Stops.

2.14 THRESHOLDS

A. Manufacturers:
1. National Guard Products, Inc: www.ngpinc.com/#sle.
2. Pemko; Assa Abloy: https://www.pemko.com/en/products/gasketing/perimeter-gaskets.
3. Substitutions: Not permitted.

B. Properties:
1. Threshold Surface: Fluted horizontal grooves across full width.

C. Grades: Thresholds: Comply with BHMA A156.21.

D. Types: As applicable to project conditions. Provide barrier-free type at every location where specified.

2.15 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:
1. National Guard Products, Inc: www.ngpinc.com/#sle.
2. Pemko; Assa Abloy: https://www.pemko.com/en/products/gasketing/perimeter-gaskets.
3. Substitutions: Not permitted.

B. Properties:
1. Weatherstripping Air Leakage Performance: Not exceeding 0.3 cfm/sq ft of door opening at 0.3 inches of water pressure differential for single doors, and 0.5 cfm/sq ft of door area at 0.3 inches of water pressure differential for double doors for gasketing other than smoke control, as tested according to ASTM E283/E283M; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

C. Grades: Comply with BHMA A156.22.

D. Products:
1. Weatherstripping: See Door Hardware Schedule.
2. Door Bottom Seals:
a. Door Sweeps: See Door Hardware Schedule.

2.16 KEYS AND CORES

A. Manufacturers:
1. BEST, dormakaba Group: www.bestaccess.com/#sle.
2. Substitutions: Not permitted.

B. Properties: Complying with guidelines of BHMA A156.28.
1. Provide small format interchangeable core.
2. Provide Patented CORMAX keys and cores.
3. Provide keying information in compliance with DHI (KSN) standards.
4. Keying Schedule: Arrange for a keying meeting, with Architect, Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying complies with project requirements.
5. Keying: Master keyed.
6. Include construction keying and control keying with removable core cylinders.
7. Supply keys in following quantities:

a. Master Keys: 4 each.
b. Construction Master Keys: 6 each.
c. Construction Keys: 15 each.
d. Construction Control Keys: 2 each.
e. Control Keys if New System: 2 each.

8. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.
9. Deliver keys with identifying tags to Owner by security shipment direct from manufacturer.
10. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."
11. Include installation of permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier.

C. Products:
1. Patented:
a. CORMAX.

2.17 KEY CABINETS

A. Manufacturers:
1. Lund Equipment Company, Inc: www.lundkey.com/#sle.
2. Telkee: www.telkee.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Properties:.
1. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.
2. Security Key Tags: For each keyed lock on project, provide one set of matching key tags for permanent attachment to one key of each set.
3. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.
4. Mounting: Wall surface mounted.
5. Capacity: Actual quantity of keys, plus 25 percent additional capacity.
6. Key cabinet lock to facility's keying system.

C. Finishes: Baked enamel, manufacturer's standard color.

D. Material: Sheet steel.

E. Products:
1. Lund.
2. Telkee.

2.18 FIRE DEPARTMENT LOCK-BOXES

A. Manufacturers:
1. Knox Company; Knox-Box Rapid Entry System www.knoxbox.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Properties:
1. Heavy-duty, recessed, solid steel box with hinged door and interior gasket seal; single drill-resistant lock with dust covers and tamper alarm.
2. Capacity: Holds 10 keys.
3. Construction complying with UL 1037, UL 1610, and UL 437.

C. Finishes: Manufacturer's standard coating.
1. Color: Manufacturer's standard dark bronze.

D. Options:. As applicable to each item specified.

E. Products:

1. Knox.

2.19 FINISHES

A. Finishes: Identified in Hardware Sets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

B. Correct all defects prior to proceeding with installation.

C. Verify that electric power is available to power operated devices and of correct characteristics.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware using the manufacturer’s fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

C. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

D. Install hardware for smoke and draft control doors in accordance with NFPA 105.

E. Use templates provided by hardware item manufacturer.

F. Do not install surface mounted items until application of finishes to substrate are fully completed.

G. Wash down masonry walls and complete painting or staining of doors and frames.

H. Complete finish flooring prior to installation of thresholds.

I. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
   1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
   2. For Steel Door Frames: See Section 081213.
   3. For Aluminum-Framed Storefront Doors and Frames: See Section 084313.
   4. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
   5. Flush Wood Doors: See Section 081416.
   6. Stile and Rail Wood Doors: See Section 081433.
   7. Mounting heights in compliance with ADA Standards:
      a. Locksets: 40-5/16 inch (1024 mm).
      b. Push Plates/Pull Bars: 42 inch (1067 mm).
      c. Deadlocks (Deadbolts): 48 inch (1219 mm).
      d. Exit Devices: 40-5/16 inch (1024 mm).
      e. Door Viewer: 43 inch (1092 mm); standard height 60 inch (1524 mm).

J. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

K. Include in installation for existing doors and frames any necessary field modification and field preparation of doors and frames for new hardware. Provide necessary fillers, reinforcements, and fasteners for mounting new hardware and to cover existing door and frame preparations.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.

3.04 ADJUSTING

A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation activities.

C. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

3.06 PROTECTION

A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

3.07 DOOR HARDWARE

Manufacturer list

BES	Best
C-R	Corbin Russwin
LCN	LCN
NGP	National Guard Products
SEL	SELECT
TRI	Trimco

Option list

Code:	Name:
S	Single Keyed Classroom
D	Storeroom
3	2-3/4" Backset
B4E Heavy	Heavy Bevel Edges
M52	Cylinder dogging (less cylinder)
AB	Entrance
VIB	Double Visual Indicator
PATD	Patented keyed core
HA	Anti-Vandal Pull without Astragal
10"	Height
7	7 Pin
X 2" LDW	Width
3	Push Plate 4" x 16"
SCUSH	Spring Cush-n-Stop Arm
4	Standard Mortise

L	Privacy Function
PATD	Patented
N	Passage
Head & Jambs (2)	Provide at the head and both jambs
0	Keyless
3B	Pull Plate 4" x 16" with 10" CTC Pull
LM	Lost Motion
LAR	Length As Required
HWPA	Heavy Duty with Parallel Arm Bracket
NRP	NON-REMOVABLE PINS
HD	Heavy Duty
CSK	Counter Sunk Holes

Finish list

Code:	Name:
B	Brown
US27	Mill Aluminum
689	Aluminum
CL	Clear
A	Anodized Aluminum
26D	Satin chromium plated
628	Satin Aluminum, clear anodized
630	Satin Stainless Steel
626	Satin chromium plated

Specification Report

Set #101

Doors: 1902

6.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Flush Bolt	3820x3810	626	TRI
1.0	Cylindrical Lock	9K 3 7 R 14 C LM PATD	626	BES
1.0	Strike	3910	626	TRI
1.0	Coordinator	3094 SERIES	628	TRI
2.0	Door Closer	4041 RWPA	689	LCN
2.0	Kick Plate	K0050 10" X 1" LDW CSK B4E	630	TRI
2.0	Dome Stop	1211	626	TRI
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP

Set #102

Doors: 1901B, 1904B

1.0	Continuous Hinge	SL24 HD	CL	SEL
1.0	Exit Device	2101 ALK 4901	630	BES
1.0	Door Closer	EHD9016 SDS	689	BES
1.0	Kick Plate	K0050 10" X 2" LDW CSK B4E Heavy	630	TRI
1.0	Threshold	8425 LAR	A	NGP
1.0	Gasketing	700S Head & Jambs (2)	US27	NGP
1.0	Sweep	200S LAR	A	NGP

Set #103

Doors: 1908A, 1963

3.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Cylindrical Lock	9K 3 7 D 14 C LM PATD	626	BES
1.0	Door Closer	QDC111	689	DK
1.0	Kick Plate	K0050 10" X 2" LDW CSK B4E Heavy	630	TRI
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP

Set #104

Doors: 1903, 1913, 1907

1.0	Continuous Hinge	SL24 HD	CL	SEL
1.0	Cylindrical Lock	9K 3 7 D 14 C LM PATD	626	BES
1.0	Door Closer	EHD9016 SDS	689	BES
1.0	Kick Plate	K0050 10" X 2" LDW CSK B4E Heavy	630	TRI
1.0	Gasketing	700S Head & Jambs (2)	US27	NGP
1.0	Sweep	200S LAR	A	NGP
1.0	Threshold	8425 LAR	A	NGP

Set #105 NOT USED

Doors:

Set #106

Doors: 1906, 1924, 1962, 1960, 1961, 1971A, 1971B, 1967, 1966, 1966B

3.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Cylindrical Lock	9K 3 7 D 14 C LM PATD	626	BES
1.0	Door Closer	QDC111	689	DK
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		

Set #107

Doors:, 1912, 1951, 1905, 1956A, 1956B, 1968A, 1968B, 1969A, 1969B

3.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Cylindrical Lock	9K 3 7 AB 14 C LM PATD	626	BES
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		

Set #108

Doors: 1918, 1917B, 1917A, 1925, 1954, 1955, 1958, 1957, 1959, 1970A, 1970B

3.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Cylindrical Lock	9K 3 7 R 14 C LM PATD	626	BES
1.0	Door Closer	QDC111	689	DK
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		

Set #109

Doors: 1953

3.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Cylindrical Lock	9K 3 0 N 14 C LM		BES
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		

Set #110

Doors: 1917A, 1917B, 1922, 1923, 1952

3.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 0 L 14 H VIB	626	BES
1.0	Door Closer	QDC119	689	DK
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		

Set #110.1

Doors: 1920

3.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 0 L 14 H VIB	626	BES
1.0	Door Closer	QDC111	689	DK
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		

Set #110.2

Doors: 1926

3.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Faculty Mortise Lock	45H 7 TD 14 H VIB	626	BES
1.0	Door Closer	QDC111	689	DK
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		

Set #110.3

Doors: 1964, 1965

3.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 0 L 14 H VIB	626	BES

1.0	Classroom Deadbolt	8T3-S PATD	626	BES
1.0	Door Closer	QDC119	689	DK
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		

Set #111

Doors: 1911, 1910, 1914, 1915, 1916, 1919, 1921, 1901A, 1904A

3.0	Hinge	FBB179 45X45	26D	BES
1.0	Push Plate	1001 3	630	TRI
1.0	Pull Plate	1018 3B	626	TRI
1.0	Classroom Deadbolt	8T3-S PATD	626	BES
1.0	Door Closer	QDC111	689	DK
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		

Set #112

Doors: C1951A, C1951B

3.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Power Transfer	EPT-12C		BES
1.0	Cylindrical Lock	9KW 3 7 DEU 14 C LM PATD RQE	626	BES
1.0	Door Closer	QDC119	689	DK
1.0	Gasketing	5050B @ HEAD & JAMBS		NGP
1.0	Wire Harness	WH-XXP		BES
1.0	Wire Harness	WH-192P		BES
1.0	Wire Harness	WH-6E		BES
1.0	Card Reader	BY SECURITY CONTRACTOR		.
1.0	Power Supply	BY SECURITY CONTRACTOR		.
1.0	Door Position Switch	BY SECURITY CONTRACTOR		.

NOTE: DOOR NORMALLY CLOSED AND LOCKED
PRESENTING VALID CREDENTIAL RELEASES LEVER AND ALLOWS FOR INGRESS.
EMERGENCY KEY OVERRIDE.
RQE SWITCH IN LEVERSET TO SHUNT ALARM UPON EGRESS.
FREE EGRESS AT ALL TIMES.

Set #113

Doors: C1900A, C1900B

2.0	Continuous Hinge	SL24 HD EPT PREP	CL	SEL
2.0	Power Transfer	EPT-12C		BES
2.0	Exit Device	TS MLR 2603 NC-03	630	BES
2.0	Pull	1097 HA	630	TRI
2.0	Mortise Cylinder	12E 7 2 PATD	626	BES
2.0	Door Closer	EHD9016 SDS	689	BES
1.0	Threshold	8425 LAR	A	NGP
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		
2.0	Sweep	200S LAR	A	NGP
2.0	Wire Harness	WH-XXP		BES
2.0	Wire Harness	WH-192P		BES
2.0	Wire Harness	WH-6E		BES
1.0	Card Reader	BY SECURITY CONTRACTOR		.
1.0	Power Supply	BY SECURITY CONTRACTOR		.
2.0	Door Position Switch	BY SECURITY CONTRACTOR		.

NOTE: AI PHONE @ C1900B
DOOR NORMALLY CLOSED AND LOCKED
PRESENTING VALID CREDENTIAL RETRACKS LATCH AND ALLOWS FOR INGRESS.
EMERGENCY KEY OVERRIDE.
TS SWITCH IN PUSHBAR TO SHUNT ALARM UPON EGRESS.
FREE EGRESS AT ALL TIMES.

Set #113.1

Doors: 1927A, 1927B

6.0	Hinge	FBB179 NRP 45X45	26D	BES
1.0	Mullion	KR822		
2.0	Exit Device	2108 4908D	630	BES
3.0	Mortise Cylinder	12E 7 2 PATD	626	BES
2.0	Door Closer	EHD9016 SDS	689	BES
2.0	Gasketing	5050B @ HEAD & JAMBS		NGP
1.0	Mullion Gasket	5100N		NGP

Set #114 - MISC

Doors: 1908B, W28, 1970C

1.0	Mortise Cylinder	12E 7 2 PATD	626	BES
1.0	Balance of Hardware	BY OPENING MANUFACTURER		BY

NOTE: COORDINATE CYLINDER CONFIGURATION (RIM OR MORTISE) WITH OPENING MANUFACTURER

Set #115

Doors: E1000A

3.0	Hinge	FBB179 45X45 NRP	26D	BES
1.0	Passage Mortise Lock	45H 0 N 14 H	626	BES
1.0	Classroom Deadbolt	8T3-L PATD	626	BES
1.0	Dome Stop	1211	626	TRI
1.0	Gasketing	BY OTHERS @ ALF | 5050B @ HMF		

END OF SECTION

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Insulating Glazing Units (GI).
   2. Laminated Galzing (GL).
   3. Tempered Glass (GT).
   4. Glazing Sealants.
   5. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

A. {RSTEMP#undefined}

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

D. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).

E. ASTM C1036 - Standard Specification for Flat Glass; 2021.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

G. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.

H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.

I. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.

J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

K. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.

L. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.

M. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

N. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

P. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

Q. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

R. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014, with Errata (2017).

S. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.

1.4 DEFINITIONS

A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C1036.

B. Interspace: Space between lites of an insulating glass unit.

1.5 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass panels including comprehensive engineering analysis by a qualified professional engineer lawfully licensed in the State of Texas, using performance requirements and design criteria indicated.

B. Installed Glazing: Design glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the BIBC and ASTM E1300.
   1. Design Wind Pressures: As indicated on Structural Drawings.
   2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
      a. Wind Design Data: As indicated on Structural Drawings.
      b. Basic Wind Speed: As indicated on Structural Drawings.
      c. Importance Factor: As indicated on Structural Drawings.
   3. Exposure Category: As indicated on Structural Drawings.
   4. Design Snow Loads: As indicated on Structural Drawings.
   5. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
   6. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
   7. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch (25 mm), whichever is less.

D. Windborne Debris Impact Resistance: Exterior glazing shall comply with -protection testing requirements in ASTM E1996 for when tested according to ASTM E1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
   1. Large Missile Test: For glazing located within 30 feet (9.1 m) of grade
   2. Small Missile Test: For glazing located more than 30 feet (9.1 m) above grade

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II

F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
   2. For laminated glass lites, properties are based on products of construction indicated.
   3. For insulating glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   4. U-Factors: Center of glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
   5. Solar Heat Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 Nand based on LBL's WINDOW 5.2 computer program.
   6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

1.6 SUBMITTALS

A. Product Data: Technical data for each type of product including recommended installation and cleaning procedures.

B. Glass Samples: For each type of glass required. Prepare samples from same material to be used for Work.

C. Glazing Schedule: List glass types and thickness for each size opening and location. Use same designations indicated on Drawings.

D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Product Certificates: Submit glass product certificates required by Code.
   1. Glass Manufacturer Certificate: The glass manufacturer shall submit a letter certifying it has reviewed the glazing details proposed for the project, including the use of gaskets and sealants, and that each product furnished is recommended for the application shown and compliance with the Code.

F. Thermal Stress and Wind Load Analyses: Submit the following from the glass manufacturer:
   1. Thermal stress analysis for each exterior glass unit type, each building elevation. The analysis shall clearly indicate the expected service temperature ranges and the effects of partial and full shading on the glass.
      a. Attach to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified statistical probability of breakage.
   2. Wind load analysis for each glass unit type, each building elevation. The analysis shall indicate the statistical probability of breakage at the design wind pressure does not exceed the specified statistical probability of breakage.

G. Product Test Reports: Submit test reports for insulating glass and glazing sealants, for tests performed by a qualified testing agency.
   1. Glazing Sealants: Provide test reports based on testing current sealant formulations within previous 36 month period.
   2. Glazing Sealants: Preconstruction adhesion and compatibility test report.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements of the IBC for glazing.
   2. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
      a. As a minimum provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission Safety Standard for Architectural Glazing Materials, published in the Code of Federal Regulations) and ANSI Z97.1.
      b. Permanently mark safety glass with certification label of Safety Glazing Certification Council.
   3. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
   4. Glazing Publications: Comply with published recommendations of glass product organizations
      a. GANA: Glazing Manual.
      b. IGMA: SIGMA TM-3000 Vertical Glazing Guidelines.
      c. GANA: Laminated Glazing Reference Manual.
      d. AAMA: AAMA GDSG-1 Glass Design for Sloped Glazing.
      e. AAMA: TIR A7 Sloped Glazing Guidelines.

f. IGMA for Sloped Glazing: IGMA TB-3001 Guidelines for Sloped Glazing.
g. IGMA for Insulating Glass: SIGMA TM-3000 North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.

5. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 listed and labeled by UL for fire ratings indicated, based on testing according to NFPA 252.
6. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
   a. Minimum Glass Thickness for Exterior Lites: 6 mm.
   b. Thickness of Tinted Glass: Provide same thickness for each tint color indicated.
7. Strength: Where annealed float glass is indicated, provide annealed float glass, heat strengthened float glass, or fully tempered float glass necessary to comply with performance requirements.
   a. Where heat strengthened float glass is indicated, provide heat strengthened float glass or fully tempered float glass necessary to comply with performance requirements.
   b. Where fully tempered float glass is indicated, provide fully tempered float glass.

B. Manufacturer Qualifications for Insulating Glass Units with Sputter Coated, Low E Coatings: Insulating glass manufacturer who is approved and certified by coated glass manufacturer.

C. Installer Qualifications, Glazer: Experience entity having minimum 5 years documented experience and who employs glass installers certified under the National Glass Association's Certified Glass Installer Program.

D. Installer Qualifications, Decorative Film: Experience entity having minimum 5 years documented experience in the installation of glass films.

E. Source Limitations for Glass and Glass Accessories: Obtain each type of glass and glass accessories from a single source.

F. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

G. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

H. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

I. Install glazing in mockups specified in to match glazing systems required for Project, including glazing methods.
   1. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

J. Pre-Construction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
   2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
   3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
   4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
   5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

K. Pre-Installation Conference: Conduct conference at site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.

D. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.

E. Comply with insulating glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees F (4.4 degrees C).

B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.10 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.11 WARRANTY

A. Coated Glass Products: Written warranty signed by manufacturer in which glass manufacturer agrees to replace coated glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   1. Warranty Period: Ten (10) years from date of Substantial Completion

B. Laminated Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace laminated glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
   1. Warranty Period: Ten (10) years from date of Substantial Completion.

C. Insulating Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace insulating glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   1. Warranty Period: Ten (10) years from date of Substantial Completion.

D. Glass Film: Written warranty signed by glass film manufacturer and installer in which manufacturer and installer agree to replace glass film that crack, peel, delaminate, discolor, change appearance, or failure to meet solar criteria within specified warranty period.
   1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Glass:
      a. Cardinal Glass Industries: www.https://www.cardinalcorp.com.
      b. Guardian Industries: www.guardianglass.com.
      c. Pilkington North America, a subsidiary of Nippon Sheet Glass Co., Ltd.: www.pilkington.com.
      d. Vetrotech Saint-Gobain International AG: www.vetrotech.com.
      e. Vitro Architectural Glass: www.vitroglazings.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 FABRICATORS

A. Manufacturer-certified fabricators.

2.3 MATERIALS

A. Clear, Annealed, Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully-Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.4 INSULATING GLAZING UNITS

A. Insulating Glazing Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.

B. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
   1. Spacer: Aluminum with black, color anodic finish. Thermally broken aluminum
   2. Desiccant: Molecular sieve or silica gel, or a blend of both.
   3. Performance Properties: Refer to Glazing schedule.

C. Spandrel Glass:
   1. Silicone Coated Spandrel Glass: ASTM C1048, Type I, Condition C, Quality-Q3.
   2. Fallout Resistance: Provide spandrel units identical to those passing fallout resistance test for spandrel glass specified in ASTM C1048.

2.5 LAMINATED GLAZING

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer, ionomeric polymer interlayer, or cast in place and cured transparent resin interlayer, as scheduled, to comply with interlayer manufacturer's written instructions.
   2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
   3. Interlayer Thickness: As required.
   4. Interlayer Color: Clear unless otherwise indicated

B. Windborne Debris Impact Resistant Laminated Glass: Comply with requirements for laminated glass except laminate glass with ionomeric polymer interlayer to comply with interlayer manufacturer's written instructions:

2.6 GLAZING ACCESSORIES

A. Compatibility: Provide glazing sealants compatible with one another and with other materials in contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, demonstrated by sealant manufacturer based on testing and field experience.

B. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

C. Colors of Exposed Glazing Sealants: As selected by Architect.

D. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dow Corning Corporation.
      b. GE Construction Sealants; Momentive Performance Materials Inc.
      c. May National Associates, Inc.; a subsidiary of Sika Corporation.
      d. Pecora Corporation.
      e. Sika Corporation.

E. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BASF Corporation; Construction Systems.
      b. Dow Corning Corporation.
      c. GE Construction Sealants; Momentive Performance Materials Inc.
      d. May National Associates, Inc.; a subsidiary of Sika Corporation.
      e. Pecora Corporation.
      f. Polymeric Systems, Inc.
      g. Sika Corporation.

F. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bostik, Inc.
      b. Dow Corning Corporation.
      c. GE Construction Sealants; Momentive Performance Materials Inc.
      d. May National Associates, Inc.; a subsidiary of Sika Corporation.
      e. Polymeric Systems, Inc.
      f. Schnee-Morehead, Inc., an ITW company.
      g. Sika Corporation.

G. Glazing Sealant: Acid curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BASF Corporation; Construction Systems.
      b. Bostik, Inc.
      c. Dow Corning Corporation.
      d. GE Construction Sealants; Momentive Performance Materials Inc.

e. May National Associates, Inc.; a subsidiary of Sika Corporation.
f. Pecora Corporation.
g. Polymeric Systems, Inc.
h. Schnee-Morehead, Inc., an ITW company.
i. Sika Corporation.

H. Glazing Sealants for Fire-Resistance-Rated Glazing Products: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Dow Corning Corporation.
b. GE Construction Sealants; Momentive Performance Materials Inc.
2. Colors of Exposed Glazing Sealants: As selected by Architect.

I. Back Bedding Mastic Glazing Tapes: Preformed, butyl based, 100 percent solids elastomeric tape; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

J. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

K. Miscellaneous Glazing Accessories: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with proven record of compatibility with surfaces contacted in installation.
1. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
2. Setting Blocks: Silicone, minimum 4 inches long and wide enough to fully support all lites of glazing unit.
3. Spacers: Silicone blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
4. Edge Blocks: Silicone material of hardness needed to limit glass lateral movement (side walking).
5. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
6. Perimeter Insulation for Fire Resistant Glazing: Product approved by testing agency listed and labeled fire resistant glazing product with which it is used for application and fire protection rating indicated.

2.7 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.
1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

2. Edge and Surface Conditions: Comply with the recommendations of AAMA Structural Properties of Glass for clean cut edges, except comply with manufacturer's recommendations.
3. Exposed Glass Edges and Surface Condition: Finish edges flat with an arrissed edge profile (small bevel of uniform width not exceeding 1.5 mm at an angle of approximately 45 degrees to the surface of the glass) with polished (surface is reflective in appearance similar to the major surface of the glass) surface.

B. Cutting: Wheel cut or sawed edges and seamed at manufacturer's option. For site cut glass, provide glass 2 inches (50.8 mm) larger than required in both dimensions to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat treated glass.

C. Butt Glazing: Clean cut or flat grind vertical edges of butt glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
1. Edges: Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Clean glazing channels and framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
1. Comply with manufacturer instructions for wiping of surfaces immediately before application of primers.
2. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.

B. Inspect each piece of glass immediately before installation. Do not install pieces improperly sized or with damaged edges, scratches, abrasion, or evidence damage. Remove labels from glass immediately after installation.

C. Examine glazing units to locate exterior and interior surfaces. Label or mark units so exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

D. Seal vent (breather or capillary) tubes in insulating glass units in accordance with insulating glass manufacturer written recommendations.

E. Glass Film Preparation:
1. Remove particulate matter on the glass surface using a scraping blade.
2. Place an absorbent towel on window sill or sash to absorb moisture generated by the film application.

3.3 GLAZING

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8 inch (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
   1. Square cut wedge shaped gaskets at corners and install gaskets as recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

K. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, the exposed edges are flush with or protrude slightly above sightline of stops.
   1. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make tapes fit opening.
   2. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
   3. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
   4. Do not remove release paper from tape until right before each glazing unit is installed.
   5. Apply heel bead of elastomeric sealant.
   6. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
   7. Apply cap bead of elastomeric sealant over exposed edge of tape.

L. Gasket Glazing (Dry): Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
   1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
   2. Installation with Drive in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket

applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

3. Installation with Pressure Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
4. Install gaskets to protrude past face of glazing stops.

M. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

N. Structurally Glazed Units: Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite.
1. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturers recommended temporary cleats.
2. Structurally seal glass unit to vertical mullions with specified one part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to face of interior glass light; remove excess structural silicone from glass and metal substrates.
3. After full cure of structural silicone sealant remove temporary cleats. Immediately seal holes left in the vertical mullions caused by temporary cleats.
4. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant.
5. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass light faces; remove excess sealant from glass and metal substrates.

O. Glass Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying in pattern indicated on Drawings to the interior face of clean glass, according to manufacturer's written instructions, using the squeegee technique to remove moisture.
1. Cut film edges neatly and square at a uniform distance of 1/16 inch (1.5 mm) to 1/32 inch (0.75 mm) of the window sealing device. Avoid scoring glass when cutting film.

P. Erection Tolerances:
1. Maximum Deviation from Vertical: 1/8 inch in any story and 1/4 inch in any 45 foot run.
2. Maximum Deviation from Horizontal: 1/8 inch in any 30 foot run.
3. Maximum Deviation from True Alignment: 1/32 inch for any two (2) abutting units. Allow no edge projections.
4. Maximum Joint Gap: 1/32 inch.

3.4 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

PART 4 SCHEDULE

4.1 GLAZING SCHEDULE

A. Insulating Glazing Units (GI):
1. General
a. Minimum Performance Requirements per ICC (IECC):
1) U-Factor: 0.50 (maximum).
2) Solar Heat Gain Coefficient: 0.25 (maximum).
2. Type GI1:
a. Basis of Design: SolarBan 70 and Clear manufactured byGuardian Glass.
b. Assembly:
1) Exterior Lite:
(a) Thickness: 1/4 inch (6 mm).
(b) Color: SolarGray.
(c) Coatings: Solarban 70 on surface #2.
2) Gap:
(a) Size: 1/2 inch (13 mm).
(b) Gas: Air.
3) Interior Lite:
(a) Thickness: 1/4 inch (6 mm).
(b) Color: Clear.
(c) Coatings: Solarban 70 on surface #3.
c. Performance:
1) Visible Transmittance (%): 56.
2) Winter Night-time U-value: 0.28 (air).
3) Solar Heat Gain Coefficient: 0.26.
4) Light to Solar Gain Ratio (LSG): 2.15.

B. Laminated Safety Glazing (GL):
1. GL1: 1/4 inch (6 mm) laminated safety glass comprised of two (2) 1/8“ (3 mm) glazing quality clear float glass lites, laminated to each side of a clear 0.03 inch polyvinyl butyral (PVB) interlayer.

C. Tempered Glazing (GT):
1. Type GT1: 1/4 inch thick glazing quality, clear, tempered float glass.

END OF SECTION 08 80 00

SECTION 08 83 00 - MIRRORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Glass Mirrors.
      a. Annealed Float Glass.

B. Related Sections:
   1. Section 05 75 00 - Decorative Formed Metal: Frames for custom mirrors.
   2. Section 06 20 00 - Finish Carpentry: Wood mirror frames.
   3. Section 10 28 00 - Toilet, Bath, and Laundry Accessories: Stock, unit mirrors.

1.3 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

D. ASTM C1036 - Standard Specification for Flat Glass; 2021.

E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

H. GANA (GM) - GANA Glazing Manual; 2022.

I. GANA (SM) - GANA Sealant Manual; 2008.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples, 3 x 3 inch (75 x 75 mm) in size, illustrating mirrors design, edging, and coloration.

E. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
   2. Extra Mirror Glazing: One of each type and size.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
   1. Maintain one copy on project site.

B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

1.6 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.7 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Mirrors:
      a. Binswanger Mirror/ACI Distribution: www.binswangerglass.com.
      b. GGI - General Glass International: www.generalglass.com.
      c. Lenoir Mirror Co.: www.lenoirmirror.com.
      d. Trulite Glass and Aluminum Solutions: www.trulite.com.
      e. Walker Glass Company Ltd.: www.walkerglass.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass: Clear, annealed float glass; ASTM C1036, with copper and silver coatings, and protective overcoating.
   1. Thickness: 1/4 inch (6.4 mm).
   2. Edges: Arrised.
   3. Size: As indicated on Drawings.

2.3 ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.

C. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.

D. Glazing Clips: Manufacturer's standard type.

E. Mirror Attachment Accessories: Stainless steel clips.

F. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
   1. Application Temperature: Minus 35 to 140 degrees F (Minus 37 to 60 degrees C) at contact surfaces.
   2. Volatile Organic Content (VOC): Less than 7 percent by weight.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.

C. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. Install mirrors in accordance with manufacturer's recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.4 CLEANING

A. Remove wet glazing materials from finish surfaces.

B. Remove labels after work is complete.

C. Clean mirrors and adjacent surfaces.

END OF SECTION 08 83 00

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SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Gypsum board.
   2. Partition framing systems.
   3. Exterior gypsum board for ceilings and soffits.
   4. Tile backing panels.
   5. Ceiling suspension systems.
   6. Accessories necessary for a complete installation.

B. Related Sections:
   1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
   2. Section 06 10 00 - Rough Carpentry: Building blocking.
   3. Section 07 92 00 - Joint Sealants: Acoustical joint sealant.

1.3 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.

E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.

G. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

J. ASTM E413 - Classification for Rating Sound Insulation; 2022.

1.4 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Comply with manufacturer's load tables and the following design pressures and deflections:
   1. Stairs, Elevator Hoistways, and Vertical Shafts: 1/120 at 10 psf.
   2. Ground Floor Lobbies: 1/120 at 15 psf.
   3. Partitions Receiving Stone Cladding, Lath and Plaster, or Plaster Veneer: 1/360 at 15 psf.
   4. Partitions Receiving Monitors, Televisions, Heavy Audio/Visual Equipment: 1/360 at 15 psf.
   5. Typical Partitions: 1/240 at 5 psf.
   6. Other Partitions: 1/240 at 5 psf.
      a. Maximum Deflection:
         1) L/240 at 5 lbf per sq. ft.

2) L/120 at 5 lbf per sq. ft.
3) L/120 at 7.5 lbf per sq. ft.
4) L/120 at 10 lbf per sq. ft.

B. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

C. STC Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

1.5 SUBMITTALS

A. Product Data: Submit For each type of drywall including calculations for loadings and stresses of exterior walls and specially fabricated framing based on manufacturer's load tables.

B. Shop Drawings: Indicate locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of work.

C. Samples:
1. Trim Accessories: Full size Sample in 12 inch (300 mm) long length for each trim accessory indicated.
2. Textured Finishes: 12 inch by 12 inch (300 mm by 300 mm) for each textured finish indicated and on same backing indicated for work.

D. Calculations: Submit calculations verifying steel partition stud minimum base metal thickness and depth compliance with Code and ASTM C645 for height, load, and deflection.

E. Evaluation Reports: ICC-ES reports for dimpled steel studs and runners and firestop tracks.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with applicable requirements of building code for interior finishes.

B. Single Source Responsibility:
1. Framing Members: Obtain steel framing members from single manufacturer.
2. Panel Products: Obtain each type of gypsum board and other panel products from single manufacturer.
3. Finishing Materials: To the extent possible, obtain finishing materials from same manufacturer supplying gypsum board products. When not possible, obtain materials from manufacturer acceptable to gypsum board manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 for gypsum board manufacturer's written instructions, whichever are more stringent.
1. Do not install paper faced gypsum panels until installation areas are enclosed and conditioned.

B. Room Temperatures: Maintain minimum 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board, maintain minimum 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.

C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

D. Do not install panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Steel Studs and Tracks:
      a. CEMCO: www.cemcosteel.com.
      b. ClarkDietrich: www.clarkdietrich.com.
      c. Custom Stud, Inc.: www.customsteelcraft.com.
      d. MBA Building Supplies: www.mbastuds.com.
      e. MRI Steel Framing, LLC: www.mristeelframing.com.
      f. Phillips Manufacturing Co.: www.phillipsmfg.com.
      g. Steel Network, Inc. (The): www.steelnetwork.com.
      h. Telling Industries: www.tellingindustries.com.
   2. Gypsum Board:
      a. Certainteed Corporation: www.certainteed.com.
      b. Georgia Pacific: www.gp.com.
      c. National Gypsum Company: www.nationalgypsum.com.
      d. USG Corporation: www.usg.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 MATERIALS

A. Framing Members: ASTM C754 for component sizes and conditions under specified maximum deflection and lateral loading conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C645 requirements for metal.
   2. Protective Coating:
      a. Standard: ASTM A653/A653M, G40, hot dip galvanized.

B. Steel Framing Components: ASTM C754 for conditions indicated; hot dip galvanize complying with ASTM A653/A653M Z180.
   1. Steel Studs and Runners: ASTM C645, 0.0179 inch (0.45 mm) minimum base metal thickness; depth indicated on Drawings.
   2. Dimpled Steel Studs and Runners: ASTM C645, equivalent to minimum base metal thickness indicated on Drawings for depth indicated on Drawings.
   3. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
   4. Cold-Rolled Channel Bridging: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges; depth indicated on Drawings.
   5. Clip Angle: Not less than 1-1/2 inches by 1-1/2 inches (38.1 mm by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
   6. Hat Shaped, Rigid Furring Channels: ASTM C645; 0.0179 inch (0.45 mm) minimum base metal thickness; depth indicated on Drawings.
   7. Resilient Furring Channels: 1/2 inch (12.7 mm) deep, steel sheet members designed to reduce sound transmission. Configuration: Asymmetrical or hat shaped.

8. Cold Rolled Furring Channels 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges.
    a. Depth: As indicated on Drawings.
    b. Furring Brackets: Adjustable, corrugated edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
    c. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
9. Z-Shaped Furring Channels: With slotted or non-slotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
10. Auxiliary Framing Materials: Fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
11. Slip Type Head Joints: Where indicated, provide one of the following:
    a. Single Long Leg Runner System: ASTM C645 top runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging, located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
    b. Double Runner System: ASTM C645 top runners, inside runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
    c. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
        1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
        2) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
        3) Superior Metal Trim; Superior Flex Track System (SFT).

C. Gypsum Board: ASTM C1396/C1396M, applicable to type of gypsum board indicated and whichever is more stringent.
1. Wall Board:
    a. Type: X.
    b. Thickness: 5/8 inch (15.9 mm).
    c. Long Edges: Tapered and featured (rounded or beveled) for pre-filling.
2. Moisture and Mold Resistant Type: Type X with moisture and mold resistant core and surfaces.
    a. Type: X.
    b. Thickness: 5/8 inch (15.9 mm).
    c. Long Edges: Tapered.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow metal frames, cast in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION

A. Installation Standard: ASTM C754, except comply with framing sizes and spacing indicated.

B. Gypsum Board Assemblies: Comply with requirements in ASTM C840 applicable to framing installation.

C. Framing Assembly: Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
   1. Install studs so flanges within framing system point in same direction. Space studs in single layer application as indicated on drawings.
   2. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
      a. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
         1) Install two studs at each jamb, unless otherwise indicated.
         2) Install cripple studs at head adjacent to each jamb stud, with minimum 1/2 inch (12.7 mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
         3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
      b. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
   3. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

D. Sound Insulation: Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

E. Gypsum Panels: Comply with ASTM C840. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
   1. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
   2. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
   3. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
   4. Form control and expansion joints with space between edges of adjoining gypsum panels.
   5. Cover both faces of support framing with gypsum panels in concealed spaces, except in chases braced internally.
      a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
      b. Fit gypsum panels around ducts, pipes, and conduits.
      c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 inch to 3/8 inch (6.4 mm to 9.5 mm) wide joints to install sealant.
   6. Isolate perimeter of gypsum board applied to non-load bearing partitions at structural abutments, except floors. Provide 1/4 inch to 1/2 inch (6.4 mm to 12.7 mm) wide spaces at

these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

7. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

F. Gypsum Board: Install interior gypsum board where indicated on drawings.
   1. Single Layer Application:
      a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
      b. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints. Stagger abutting end joints not less than one framing member in alternate courses of panels.
      c. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
   2. Multilayer Application:
      a. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
      b. On Z shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
      c. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

G. Backing Panels:
   1. Cementitious Backer Units: ANSI A108.11; install where indicated with 1/4 inch (6.4 mm) gap where panels abut other construction or penetrations. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

H. Exterior Gypsum Board Soffits: Apply panels perpendicular to supports, with end joints staggered and located over supports.
   1. Install with 1/4 inch (6.4 mm) open space where panels abut other construction or structural penetrations.
   2. Fasten with corrosion-resistant screws.

I. Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Attach trim according to manufacturer's written instructions.

J. Gypsum Board Finishing: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
   1. Pre-fill open joints, rounded or beveled edges, and damaged surface areas.
   2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
   3. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
      a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
      b. Level 2: Panels that are substrate for tile.
      c. Level 3: Where indicated on Drawings.
      d. Level 4: For surfaces receiving flat paints.
      e. Level 5: For surfaces receiving gloss or semi-gloss paint, subjected to severe lighting, or receiving wall covering.

4. Glass Mat Faced Panels: Finish according to manufacturer's written instructions.

K. Installation Tolerances:
1. Suspension System: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
2. Installation Tolerances, Suspension System: Install suspension systems level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

L. Fire-Resistance-Rated and Smoke Partitions Markings
1. Each fire-resistance rated partition, smoke partition, or other wall requiring protected openings is to be marked as such as defined below.
a. Location: Mark walls in accessible concealed floor, floor-ceiling, and attic spaces.
b. Spacing: Markings shall be located within 15 feet of the end of each wall and at intervals not exceeding 30 feet measured horizontally along the wall or partition.
c. Lettering: Stenciled letters a minimum of 3 inches in height with a minimum 3/8 inch stroke in a color contrasting with the wall material (typically black) paint. Markings shall be one of the following, appropriate to the partition type, as indicated on plans.
1) “SMOKE PARTITION – PROTECT ALL OPENINGS”.
2) “#-HR FIRE BARRIER – PROTECT ALL OPENINGS” where #-HR is as indicated on the Drawings.
3) “#-HR FIRE WALL – PROTECT ALL OPENINGS” where #-HR is as indicated on the Drawings.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 16

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SECTION 09 30 00 - TILING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Ceramic Tile.
   2. Porcelain Tile.
   3. Accessories as required for a complete installation.

B. Related Sections:
   1. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

1.3 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.

B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.

C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.

D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.

E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.

F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.

G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.

H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2024).

I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.

J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).

K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

L. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.

M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).

N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.

O. ANSI A118.1 - American National Standard Specifications for Dry-Set Cement Mortar; 2023.

P. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.

Q. {RSTEMP#222}ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar{CH#60314}.

R. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.

S. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.

T. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.

U. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.

V. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2017 (Reaffirmed 2022).

W. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).

X. ANSI A118.13 - American National Standard Specifications for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation; 2014.

Y. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2023.

Z. ANSI A136.1 - American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile; 2020.

AA. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

BB. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).

CC. ASTM C847 - Standard Specification for Metal Lath; 2018.

DD. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.

EE. ASTM D4068 - Standard Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane; 2017 (Reapproved 2022).

FF. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine; 2022.

GG. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors; 2021.

HH. ICC-ES AC380 - Acceptance Criteria for Termite Physical Barrier Systems; 2021, with Editorial Revision (2022).

II. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene a pre-installation meeting one week before starting work of this section; require attendance by affected installers.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches (457 by 457 mm) in size illustrating pattern, color variations, and grout joint size variations.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.

G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
   2. Extra Tile: 5 percent of each size, color, and surface finish combination.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

B. Installer Qualifications:
   1. Company specializing in performing tile installation, with minimum of five years of documented experience.
   2. Installer Certification:
      a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
      b. Apprenticeship Program: Installer has achieved Journeyworker status through an apprenticeship from the International Union of Bricklayers and Allied Craftworkers (IUBAC) or a U.S. Department of Labor (DOL)-recognized program.
      c. Advanced Certifications for Tile Installers (ACT): Certification in the installation of membranes, mortar bed (mud) floors, mortar (mud) walls, shower receptors, large format tile, gauged porcelain tile/panels/slabs, and grouts.
      d. International Masonry Training and Education Foundation (IMTEF): Supervisor Certification Program (SCP).

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Ceramic Tile:
      a. American Olean Tile Co., a division of Mohawk Industries, Inc.: www.americanolean.com.
      b. American Tile Company: www.americantilecompany.com.

c. Dal-Tile Corp., a division of Mohawk Industries, Inc.: www.daltile.com.
d. Emser Tile.
e. Interceramic, USA: www.interceramicusa.com.
f. Marazzi Tile, Inc., a division of Mohawk Industries, Inc.: www.marazziusa.com.
g. Roca Tile USA, a division of The Roca Tile Group: www.rocatileusa.com.
h. United States Ceramic Tile Co., a division of The Roca Tile Group: www.rocatileusa.com.

2. Porcelain Tile:
a. American Olean Tile Co., a division of Mohawk Industries, Inc.: www.americanolean.com.
b. Atlas Concorde.
c. American Tile Company: www.americantilecompany.com.
d. Concept Surfaces: www.conceptsurfaces.com.
e. Crossville, Inc.: www.crossvilleinc.com.
f. Dal-Tile Corp., a division of Mohawk Industries, Inc.: www.daltile.com.
g. Emser Tile: https://www.emser.com.
h. Interceramic, USA: www.interceramicusa.com.
i. Marazzi Tile, Inc., a division of Mohawk Industries, Inc.: www.marazziusa.com.
j. TileBar: www.tilebar.com.

3. Tile Setting and Grout Materials: Those manufactured by tile manufacturers named above or any of the following as approved by tile manufacturer for use with their tile and to suit application.
a. ARDEX Engineered Cements: www.ardexamericas.com.
b. Bostik Inc: www.bostik-us.com.
c. Custom Building Products: www.custombuildingproducts.com.
d. H.B. Fuller Construction Products, Inc: www.tecspecialty.com.
e. LATICRETE International, Inc: www.laticrete.com.
f. Mapei Americas: www.mapei.com.
g. Merkrete, by Parex USA, Inc: www.merkrete.com.
h. Texrite: www.texrite.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 TILE SCHEDULE

A. Tile Type T-3-4 :
1. Basis of Design:
a. Products manufactured by Crossville.
b. Line: Urbanology.
c. Color:
1) T3: Metropolis.
2) T4: Titanium.
d. Finish: Chiseles.
2. Material: Porcelain.
3. Size: 24 inches by 48 inches.

B. Tile Type T-5-7 :
1. Basis of Design:
a. Products manufactured by Emser.
b. Line: Raku.
c. Color:
1) T5: White.

2) T6: Charcoal.
3) T7: Mustard.

d. Finish: Matte.

2. Material: Ceramic.
3. Size: 3 inches by 12 inches.

2.3 CERAMIC TILE

A. Composition: ANSI A137.1 standard grade.

B. Size: As scheduled.

C. Thickness: Refer to Basis of Design product.

D. Shape: As scheduled.

E. Surface Finish: As scheduled.

F. Color(s): As scheduled.

G. Trim Units: Matching bead, cove, and surface bullnose shapes in sizes coordinated with field tile.

2.4 PORCELAIN TILE

A. Composition: ANSI A137.1 standard grade.

B. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.

C. Size: As scheduled.

D. Thickness: Refer to Basis of Design product.

E. Surface Finish: As scheduled.

F. Color(s): As scheduled.

2.5 TRIM AND ACCESSORIES

A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
   1. Applications:
      a. Open Edges: Bullnose.
      b. Inside Corners: Jointed.
      c. Floor to Wall Joints: Cove base.
   2. Manufacturers: Same as for tile.

B. Metal Trim: Refer to Section 05 75 00 - Decorative Formed Metal.
   1. Applications:
      a. Open edges of wall tile.
      b. Open edges of floor tile.
      c. Wall corners, outside and inside.
      d. Transition between floor finishes of different heights.
      e. Expansion and control joints, floor and wall.
      f. Floor to wall joints.
      g. Borders and other trim as indicated on drawings.
      h. Balcony and terrace edge trim and fascia.

C. Thresholds: 2 inches (51 mm) wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
   1. Thickness: 1/2 inch (12.7 mm).
   2. Material: Marble, honed finish.
   3. Applications:
      a. At doorways where tile terminates.

2.6 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Latex-Portland Cement Mortar Bond Coat: {RS#222}.
   1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
   2. Basis of Design Product(s):

C. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
   1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
   2. Basis of Design Product(s):
      a. S 28 manufactured by ARDEX Engineered Cements.
      b. Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer manufactrued by Custom Building Products.
      c. TEC 3N1 Performance Mortar manufactured by H.B. Fuller Construction Products, Inc.
      d. MULTIMAX LITE manufactured by LATICRETE International, Inc.

D. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
   1. Applications: Where indicated on drawings.
   2. Basis of Design Product(s):
      a. EBM-Lite Epoxy Bonding Mortar manufactrued by Custom Building Products.
      b. LATICRETE LATAPOXY 300 Adhesive manufactured by LATICRETE International, Inc.
      c. Merkrete Pro Epoxy manufactured by Merkrete, by Parex USA, Inc.

E. Organic Adhesive: ANSI A136.1, thinset mastic type.
   1. Use Type I in areas subject to prolonged moisture exposure.
   2. Basis of Design Product(s):
      a. ARDEX D14 manufactured by ARDEX Engineered Cements.
      b. ReliaBond Ceramic Tile Adhesive - Type 1 manufactured by Custom Building Products.
      c. LATICRETE 15 Premium Mastic manufactured by LATICRETE International, Inc.
      d. Merkrete Merstik manufactured by Merkrete, by Parex USA, Inc.

F. Water Based Adhesive: Multi-purpose type mastic.
   1. Basis of Design Product(s):
      a. M420 Spot Tack manufactured by Stauf USA, LLC.

G. Adhesive for Bonding Fleece-Backed Underlayments to Non-Cementitious Substrates: Water-based rubber resin.
   1. Basis of Design Product(s):

H. Dry-Set Portland Cement Mortar Bond Coat: ANSI A118.1.
   1. Basis of Design Product(s):
      a. ____ manufactured by ____.

I. Mortar Bond Coat For Exterior Glue Plywood: ANSI A118.11.
   1. Applications: Use this type of bond coat where thin-set installation is indicated over plywood.
   2. Basis of Design Product(s):
      a. ARDEX X 5 manufactured by ARDEX Engineered Cements.
      b. Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar manufacturerd by Custom Building Products.
      c. LATICRETE 254 Platinum manufactured by LATICRETE International, Inc.
      d. Merkrete 7D10 Dust Less Thin Set manufactured byMerkrete, by Parex USA, Inc.

J. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.

1. Basis of Design Product(s):
    a. A 38 manufactrued by ARDEX Engineered Cements.
    b. LATICRETE 3701 Fortified Mortar Bed manufactrued by LATICRETE International, Inc.
    c. Merkrete Underlay C manufactured by Merkrete, by Parex USA, Inc.
    d. MSI - Mud Set Installation manufactured by Proflex Products, Inc.

2.7 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
    1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
    2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
    3. Color(s): As selected by Architect from manufacturer's full line.
    4. Basis of Design Product(s):
        a. ARDEX FL manufactured by ARDEX Engineered Cements.
        b. Prism Color Consistent Grout manufactured by Custom Building Products.
        c. TEC AccuColor Plus Grout manufactrued by H.B. Fuller Construction Products, Inc.
        d. LATICRETE PERMACOLOR Grout manufactured by LATICRETE International, Inc.
        e. Merkrete Pro Grout manufactured by Merkrete, by Parex USA, Inc.

C. Standard Grout: ANSI A118.6 standard cement grout.
    1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
    2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
    3. Color(s):As selected by Architect from manufacturer's full line.
    4. Basis of Design Product(s):
        a. Polyblend Non-Sanded Grout manufactured by Custom Building Products.
        b. LATICRETE 1500 Sanded Grout manufactured by LATICRETE International, Inc.
        c. Merkrete Duracolor Non-Sanded Grout manufactured by Merkrete, by Parex USA, Inc.

D. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
    1. Applications: As indicated on Drawings.
    2. Color(s): As selected by Architect from manufacturer's full line.
    3. Basis of Design Product(s):
        a. ARDEX WA manufactured by ARDEX Engineered Cements.
        b. CEG-IG 100% Solids Industrial Grade Epoxy Grout manufactured by Custom Building Products.
        c. TEC AccuColor EFX Epoxy Special Effects Grout manufactured by H.B. Fuller Construction Products, Inc.
        d. LATICRETE SPECTRALOCK PRO Premium Grout manufactured by LATICRETE International, Inc.
        e. Merkrete Pro Epoxy manufactured by Merkrete, by Parex USA, Inc.
        f. Marcoat GS manufactured by Stuart Dean Company, Inc.

2.8 MAINTENANCE MATERIALS

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
    1. Applications: Between tile and plumbing fixtures.
    2. Color(s): As indicated on Drawings.
    3. Basis of Design Product(s):
        a. ARDEX SX manufactured by ARDEX Engineered Cements.

b. Commercial 100% Silicone Caulk manufactured by Custom Building Products.
c. LATICRETE LATASIL manufactrued by LATICRETE International, Inc.
d. Merkrete Colored Caulking manufactured by Merkrete, by Parex USA, Inc.
e. Merkrete Colored Caulking manufactured by Rust-Oleum Corporation.

B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
1. Composition: Water-based colorless silicone.

C. Tile Sealer: Stain protection for ceramic tile and porcelain tile tile.
1. Basis of Design Product(s):
a. Aqua Mix Enrich 'N' Seal manufactured by Custom Building Products.
b. Miracle Sealants 511 Impregnator Natural Looking Penetrating Sealer manufactured by Rust-Oleum Corporation.
c. STONETECH Heavy Duty Stone Sealer manufactured by STONETECH, a division of LATICRETE international, Inc.

D. Grout Release: Temporary, water-soluble pre-grout coating.
1. Basis of Design Product(s):
a. Aqua Mix Grout Release manufactured by Custom Building Products.

2.9 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
1. Crack Resistance: No failure at 1/8 inch (3.2 mm) gap, minimum.
2. Fluid or Trowel Applied Type:
a. Material: Synthetic rubber or Acrylic.
b. Thickness: 20 mils (0.5 mm), maximum.
c. Basis of Design Product(s):
1) TEC HydraFlex Waterproofing Crack Isolation Membrane manufactured by H.B. Fuller Construction Products, Inc.
2) LATICRETE Blue 92 Anti-Fracture Membrane manufactured by LATICRETE International, Inc.
3) Merkrete Fracture Guard manufactured by Merkrete, by Parex USA, Inc.
3. Peel-and-Stick Sheet Type:
a. Material: Rubberized membrane laminated to reinforcing fabric.
b. Thickness: 20 mils (0.5 mm), maximum.
c. Basis of Design Product(s):
1) Maxxim Sim-40 manufactured by Proflex Products, Inc.
2) AFM Anti-Fracture Membrane manufactured by Protecto Wrap.

B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.

C. Waterproofing Membrane at Showers and Tiled Tubs: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
1. Fluid or Trowel Applied Type:
a. Material: Synthetic rubber.
b. Basis of Design Product(s):
1) LATICRETE HYDRO BAN manufactued by LATICRETE International, Inc.

D. Waterproofing Membrane Under Thick Mortar Bed at Showers and Tiled Tubs:
1. Material: Chlorinated polyethylene sheet, 40 mils (1.0 mm) thick, minimum; complying with ASTM D4068.
2. Basis of Design Product(s):
a. Chloraloy Shower Pan Liner manufactued by Noble Company.

E. Cleavage Membrane Under Thick Mortar Bed:

1. Material: No. 15 (6.9 kg) asphalt saturated felt.
2. Material: 4 mil (0.1 mm) thick polyethylene film.
3. Material: Reinforced asphalt paper.
4. Basis of Design Product(s):

F. Reinforcing Mesh: 2 by 2 inch (51 by 51 mm) size weave of 16/16 wire size; welded fabric, galvanized.

G. Metal Lath: ASTM C847 Flat diamond mesh, of weight to suit application, galvanized finish.

H. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
1. Sound Reduction: Comply with ANSI A118.13 bonded membrane, ASTM E492, and ASTM E2179.
2. Crack Resistance: No failure at 1/16 inch (1.6 mm) gap, minimum; comply with ANSI A118.12.
3. Water Resistance: Comply with ANSI A118.10, bonded waterproofing.
4. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
5. Uncoupling Function: Allow for separation between membrane and the mortar adhering tile to the membrane when subjected to excessive substrate movement.
6. Suitable for installation over green concrete.
7. Suitable for installation over wood-based substrates.

I. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch (11 mm) thick; 2 inch (51 mm) wide, alkali-resistant, coated glass fiber mesh tape for joints and corners.
1. Basis of Design Product(s):

J. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
1. Standard Type: Thickness 1/2 inch (12.7 mm).
2. Fire Resistant Type: Type X core, thickness 5/8 inch (15.9 mm).
3. Basis of Design Product(s):

K. Backer Board: High density polystyrene with reinforced cementitious coating on both sides; with compatible alkaline resistant joint tape; to be covered with waterproofing prior to installation of tile.
1. Thickness: 1/2 inch (12.7 mm).
2. Basis of Design Product(s):

L. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
2. Follow moisture and alkalinity remediation procedures in Section 09 05 61 - Common Work Results for Flooring Preparation.

3.2 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Install thresholds where indicated.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control and expansion joints free of mortar, grout, and adhesive.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 CLEANING

A. Clean tile and grout surfaces.

3.5 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 09 30 00

SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Suspended metal grid ceiling system.
   2. Suspended plastic grid ceiling system.
   3. Acoustical units.
   4. Supplementary acoustical insulation above ceiling.

B. Related Sections:
   1. Section 07 21 00 - Thermal Insulation; Acoustical insulation.

1.3 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

E. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.

F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

G. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

H. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

I. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

L. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

M. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.

N. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

O. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.

P. CHPS (HPPD) - High Performance Products Database; Current Edition.

Q. ISO 14644-1 - Cleanrooms and associated controlled environments - Part 1: Classification of air cleanliness by particle concentration; 2015.

R. ITS (DIR) - Directory of Listed Products; Current Edition.

S. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

T. UL (FRD) - Fire Resistance Directory; Current Edition.

U. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning.

C. Product Data: Provide data on suspension system components and acoustical units.

D. Evaluation Service Reports: Show compliance with specified requirements.

E. Samples: Submit two samples 6 by 6 inch (150 by 150 mm) in size illustrating material and finish of acoustical units, including edge.

F. Samples: Submit two samples each, 6 inches (150 mm) long, of suspension system main runner, cross runner, and perimeter molding.

G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

H. Designer's Qualification Statement.

I. Manufacturer's Qualification Statement.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of each type installed, to a minium of one box of each..

1.6 QUALITY ASSURANCE

A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 55 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Acoustic Panels:

a. Armstrong World Industries, Inc.: www.armstrongceilings.com.
b. Acoustic Ceiling Products, Inc.: www.acpideas.com.
c. Acoustics First Corporation: www.acousticsfirst.com.
d. CertainTeed Corporation: www.certainteed.com.
e. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
f. Nelson Industrial, Inc: www.nelsonii.com/arch.
g. TECHLITE: www.techlite.com.
h. USG Corporation: www.usg.com/ceilings.
i. _____.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 PANELS

A. General Requirements: ASTM E1264, Class A.
1. VOC Content: Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
2. VOC Content: Certified as Low Emission by one of the following:
a. Product listing in UL (GGG).
b. Product listing in CHPS (HPPD).

B. Acoustical Ceiling Panel (ACP-1): Glass fiber with membrane-faced overlay, with the following characteristics:
1. Basis of Design: Optima manufactured by Armstrong World Industries, Inc.
2. Classification: ASTM E1264 Type XII.
a. Form: 2, cloth.
b. Pattern: "E" - lightly textuured.
3. Panel Edge: 15/16" Square Tegular.
4. Size: 24 by 24 inches (610 by 610 mm).
5. Minimum NRC: Up to 1.00, determined in accordance with ASTM E1264.
6. Articulation Class (AC): up to 190, determined in accordance with ASTM E1264.
7. Color: White
8. Suspension System (ACS-1):Prelude XL.

2.3 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.

C. Hold-Down Clips: Manufacturer's standard clips to suit application.

D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.

E. Wood Veneer Panel Safety Clips: Galvanized 1-9/16 by 5-1/2 inch (40 by 139 mm) bent sheet metal clips screw anchored to back of adjacent panels and spanning over top of suspended tee grid.
1. Wire Ties: No. 12 galvanized wire.

F. Wood Veneer Perimeter Trim: Field cut wood veneer panels to match acoustic ceiling panels.
1. Support: Aluminum L angle, 1/8 inch (3.2 mm) thick.

G. Perimeter Moldings: Same metal and finish as grid.
1. Size: As required for installation conditions and specified Seismic Design Category.
2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
3. Shadow Molding: Shaped to create a perimeter reveal.
a. Basis of Design:

1) AXIOM AXM7575STR manufactured by Armstrong World Industries, Inc.

4. Channel Molding: U-shaped, for hold-down type installations.
5. Gaskets For Perimeter Moldings: Closed-cell foam, factory-applied to molding.
6. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.

H. Metal Edge Trim for "Cloud" Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
1. Basis of Design: Axiom as manufactured by Armstrong World Industries, Inc.
2. Trim Height: As indicated on Drawings.
3. Finish: Baked enamel.
4. Color: As indicated on Drawings.

I. Ceiling Pockets with Prewired Raceway: UL 325 listed, extruded aluminum shade pocket with removable closure panel and acoustical unit support, for recess mounting in suspended acoustical or drywall ceilings; size and configuration as indicated on drawings.
1. Basis of Design:
a. Axiom Building Perimeter System AXP355 manufactured by Armstrong World Industries.
2. Designed to accommodate installation of motor control and wiring accessories within pocket.

J. Acoustical Insulation: Refer to Section 07 21 00 - Thermal Insulation.

K. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.2 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.3 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

D. Locate system on room axis according to reflected plan.

E. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Install in bed of acoustical sealant.
2. Use longest practical lengths.
3. Overlap and rivet corners.

F. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

G. Seismic Suspension System, Seismic Design Category C: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Maintain a 3/8 inch (9 mm) clearance between grid ends and wall.

H. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch (19 mm) clearance between grid ends and wall.

I. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

J. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

K. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.

L. Do not eccentrically load system or induce rotation of runners.

M. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.

N. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

3.4 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Lay directional patterned units with pattern parallel to longest room axis.

D. Fit border trim neatly against abutting surfaces.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.

G. Where round obstructions occur, provide preformed closures to match perimeter molding.

H. Lay acoustical insulation for a distance of 48 inches (1219 mm) either side of acoustical partitions as indicated.

I. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

J. Install hold-down clips on panels within 8 ft (2.5 m) of an exterior door.

K. Install plastic lay-in panels at following minimum distance from conventional light sources:
   1. Halogen, 60 Watt: 14 inches (355 mm) minimum.
   2. Incandescent, 120 Watt: 15 inches (380 mm) minimum.
   3. Quartz Halogen, 500 Watt: 23 inches (584 mm) minimum.
   4. _____: _____ inch (_____ mm).

L. Install safety clips on wood veneer panels 2 inches (51 mm) from outside edge of panel and at 24 inches (610 mm) on center.
   1. Use wire ties to attach safety clips.

M. Install wood veneer trim using aluminum L angle to attach to suspended grid system as required for application.

3.5 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 09 51 00

SECTION 09 54 26 - SUSPENDED WOOD CEILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood grilles.
   2. Metal suspension system.

B. Related Sections:

1.2 RELATED REQUIREMENTS

A. Section 09 51 00 - Acoustical Ceilings: Metal suspension systems.

1.3 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

E. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

F. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

H. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

I. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

J. CISCA (WC) - Wood Ceilings Technical Guidelines; 2009.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure ceilings are not installed until building is enclosed, dust generating activities have terminated, and overhead work is completed.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning, attachment of wood ceiling components to grid, accessory attachments, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

C. Product Data: Provide data on wood ceiling components and suspension system components.

D. Samples: Submit two full size samples illustrating material and finish of wood ceiling components.

E. Samples: Submit two samples each, ____ inches (____ mm) long, of suspension system main runner, cross runner, and perimeter molding.

F. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for fire, acoustical, and seismic performance.

G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

H. Designer's Qualification Statement.

I. Manufacturer's Qualification Statement.

J. Installer's Qualification Statement.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
   2. Wood Ceiling Components: Provide a quantity equal to 2 percent of total product installed.

1.6 QUALITY ASSURANCE

A. Designer Qualifications for Seismic Design: Under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section.
   1. Minimum 3 years documented experience.
   2. Approved by wood ceiling manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood ceiling components to project site in original, unopened packages.

B. Store in fully enclosed space, flat, level and off the floor.

1.8 FIELD CONDITIONS

A. Do not install suspended wood ceiling system until wet construction work is complete and permanent heat and air conditioning is installed and operating.

B. Maintain room temperature between 60 degrees F (16 degrees C) and 75 degrees F (24 degrees C) and relative humidity between 35 to 55 percent before, during, and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. 9Wood: www.9wood.com.
   2. Architectural Components Group, Inc.: www.acgiwood.com.
   3. Armstrong World Industries. Inc.: www.armstrongceilings.com.
   4. Navy Island, Inc.: www.navyisland.com.
   5. Rulon International: www.rulonco.com.
   6. USG Corporation: www.usg.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 SUSPENDED WOOD CEILING SYSTEM

A. Performance Requirements:
   1. Design for maximum deflection of 1/360 of span.
   2. Design to resist seismic load by using practices specified in ASTM E580.

B. Wood-Based Materials:
   1. Certified as sustainably harvested as specified in Section 01 60 00 - Product Requirements.
   2. Solid Wood: Clear, dry, sound, plain sawn, selected for compatible species, grain and color, no defects.
   3. Composite Wood Panels: Containing no urea-formaldehyde resin binders.

C. Wood Ceiling and Wall Grille System Type - WCS-1:
   1. Description: Wood micro grille.
   2. Basis of Design:
      a. 1100 Cross Piece Grille as manufactured by 9Wood.
   3. Panel:
      a. Length: Refer to Drawings.
      b. Thickness: 4 inches.
      c. Blades:
         1) Thickness: 4 inches.
         2) Height: 1 inch (25 mm).
         3) Spacing: 4 inches.
         4) Wood:
            (a) Species: Western Hemlock..
            (b) Cut: As selected by the Architect.
            (c) Factory Finish: As scheduled.
      d. Backers:
         1) Notched, painted wood.
            (a) Color: Black.

D. Metal Suspension System:
   1. General: Comply with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
      a. Materials:
         1) Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
         2) Aluminum Grid: Aluminum sheet, ASTM B209 (ASTM B209M).
         3) Stainless Steel Grid: ASTM A666, Type 304.
   2. Exposed Suspension System Type ____: Hot-dipped galvanized steel grid and cap.
      a. Basis of Design:
      b. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
      c. Profile: Tee; 15/16 inch (24 mm) face width.
      d. Finish/Color: Baked enamel, black.
   3. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement.

E. Accessories: Manufacturer's standard accessories for installation method indicated, seismic requirements and above-ceiling accessibility.

2.3 FABRICATION

A. Shop fabricate wood ceiling components to the greatest extent possible.

B. Fabricate components to allow access to ceiling plenum as required.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not install ceiling until after interior wet work is dry.

3.2 PREPARATION

A. Coordinate the location of hangers with other work.

B. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

C. Layout wood ceiling components in pattern according to reflected ceiling plan and as shown on shop drawings.

D. Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 48 hours prior to installation.

3.3 INSTALLATION

A. General: Install suspended wood ceiling system in accordance with CISCA (WC).

B. Suspension System:
   1. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
   2. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
   3. 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.
   4. 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.
   5. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
   6. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
   7. Do not eccentrically load system or induce rotation of runners.
   8. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.

C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.

D. Wood Ceiling:
   1. Install wood ceilings in accordance with manufacturer's instructions.
   2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
   3. Install components in uniform plane, and free from twist, warp, and dents.
   4. Cut to fit irregular grid and perimeter edge trim.
   5. Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.
   6. Install clips, stabilizer bars, and other attachments as indicated to secure wood ceiling components tight to the grid system.
   7. Install acoustical backer above wood ceiling components; fit tight between grid members.

3.4 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

3.5 CLEANING

A. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION 09 54 26

SECTION 09 65 00 - RESILIENT FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Resilient tile flooring
   2. Installation accessories.

B. Related Sections:
   1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
   2. Division 26: Electrical floor cover plates for installation of resilient flooring specified in this section.

1.3 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.

B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2018).

C. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate seaming plans and floor patterns.

D. Verification Samples: Submit two samples, 6 by 6 inch (150 by 150 mm) in size illustrating color and pattern for each resilient flooring product specified.

E. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.

F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.

G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 78 23 - Operation and Maintenance Data for additional provisions.
   2. Extra Flooring Material: Provide extra flooring material equal to 1 percent of each type and color of installed flooring, minimum of 10 square feet (1 square meters).

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).

D. Do not double stack pallets.

1.7 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 GENERAL REQUIREMENTS

A. Unless noted otherwise, all Resilient Flooring shall comply with the following:
   1. VOC Content Limits: As specified in Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
   2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.

2.3 RESILIENT TILE FLOORING

A. General Requirements
   1. Size(s): As indciated on Drawings.

B. Vinyl Composition Tile - Type RFT 1-3: Homogeneous, with color extending throughout thickness.
   1. Manufacturers: Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
      a. Tarkett.
   2. Basis of Design:
      a. Manufacturer: Tarkett.
      b. Collection: Contour Color Beam.
      c. Emboss: Quarry.
      d. Color:
         1) RFT-1: C113 Moonlight.
         2) RFT-2: C121 Flannel.
         3) RFT-3: C120 Eclipse.
   3. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
   4. Thickness: 0.125 inch (3.2 mm).

2.4 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Adhesive for Vinyl and Rubber Flooring:
   1. Manufacturers: Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
      a. H.B. Fuller Construction Products, Inc: www.tecspecialty.com.
      b. Loba-Wakol, LLC: www.loba-wakol.com.
      c. Stauf USA, LLC: www.staufusa.com.

C. Moldings, Transition and Edge Strips:
   1. Metal Moldings, Transition and Edge Strips: Refer to Section 05 75 00 - Decorative Formed Metal.
   2. Resilient Moldings, Transition and Edge Strips: Refer to Section 09 65 13 - Resilient Base and Accessories.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

D. Clean substrate.

E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

F. Install flooring in recessed floor access covers, maintaining floor pattern.

3.4 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.5 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.6 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 09 65 00

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SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes
   1. Resilient base, adhesive attached, in locations shown on drawings.
   2. Resilient subfloor transitions.

1.3 REFERENCE STANDARDS

A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturer’s specifications and other data needed to demonstrate compliance with specified requirements.
   2. Manufacturer’s installation instructions.

B. Samples:
   1. Actual samples or color charts showing manufacturer’s full range of colors, for Architect’s selection (if selections are not already scheduled or otherwise indicated on the drawings).
   2. Actual 12-inch-long piece of base material in each color selected for approval.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers listed, whose product meets or exceeds the specifications are approved for use on the Project with Architect’s approval. Other manufacturers must have a minimum of five (5) years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
   1. Burke Flooring.
   2. Flexco.
   3. Johnsonite.
   4. Mannington.
   5. Nora Rubber Products.
   6. Roppe Corp.
   7. Tarkett.

2.2 MATERIALS

A. Standard Rubber Base (typical except where extended toe or other type of base is specifically indicated on drawings, e.g., at athletic flooring or elsewhere) (RB-1):
   1. Quality Standard: ASTM F1861.
   2. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B. Vinyl base and Type TP are not acceptable.
   3. Manufacturing Method: Group I (solid, homogeneous)
   4. Style: Topset cove; rolls of greatest length available, cut to length required to minimize joints.
   5. Minimum Thickness: Full 1/8 inch (3.2 mm)
   6. Color(s): As scheduled or otherwise indicated on the drawings, or if not so indicated, as selected by Architect.
   7. Height: 4 inches, unless indicated otherwise
   8. Corners: Job-Formed.
   9. Basis of Design: Products as manufactured by, Johnsonite.

B. Resilient Nosing (RN-1) (RN-1):
   1. Usage: For use at interior stairs, as indicated on Drawings.
   2. Type: Linear Stair Nosing.
   3. Thickness: 1/8 inch at tread.
   4. Material: Rubber or vinyl as recommended by manufacturer to suit application.
   5. Color(s): As selected by Architect.
   6. Manufacturers: Burke Flooring, Flexco, Johnsonite, Mannington Commercial, Mohawk, Roppe, Tarkett, or Architect approved equal.
   7. Basis of Design: Model 565 “Double Undercut Carpet Stair” as manufactured by Mannington Commercial.

C. Resilient Subfloor Transition (RST):
   1. Usage: Subfloor Transition System.
   2. Thickness: Varies, cut to length.
   3. Material: Rubber or vinyl as recommended by manufacturer to suit application.
   4. Basis of Design: “The Equalizer Transition” as manufactured by Mannington Commercial.

D. Adhesive: Rubber-based type; same brand as base or as recommended and approved by base manufacturer to suit application.

E. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation.

2.3 EXTRA STOCK

A. Deliver to Owner:
   1. percent, or one (1) unopened carton of each color, type and size of base selected, whichever is greater.
   2. One (1) gallon container of each type adhesive used for base.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which Work of this Section will be performed. Report unsatisfactory conditions to Architect in writing. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Prepare substrates to receive base as recommended by base manufacturer.

B. Verify substrates are smooth and ready to receive resilient base. Grind high spots and fill low spots with latex cementitious filler as required.

C. Starting Work indicates acceptance of existing conditions.

3.3 INSTALLATION

A. General:
   1. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
   2. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.

B. Installing Base:
   1. Install base where shown on the Drawings in accordance with manufacturer’s instructions.
   2. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners, as indicated on the drawings or directed by Architect.

3.4 CLEANING AND PROTECTING

A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

END OF SECTION 09 65 13

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SECTION 09 65 66 - RESILIENT ATHLETIC FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Rubber sheet flooring, adhesively installed.

B. Related Requirements:

1.3 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

B. DIN EN 14904 - Surfaces for Sports Areas – Indoor Surfaces for Multi-Sports Use – Specification; 2006.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's printed data sheets for products specified.

C. Shop Drawings: Fabrication and installation details, and layout, colors, and widths of game lines and equipment locations.

D. Selection Samples: Manufacturer's color charts for flooring materials specified and game line paints, indicating full range of colors and textures available.

E. Verification Samples: Actual flooring material specified, not less than 12 inch (305 mm) square, mounted on solid backing.
   1. Include samples of game lines, illustrating colors selected.

F. Test Reports: Submit test reports showing compliance with DIN EN 14904.

G. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

H. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.

I. Manufacturer's Instructions: Indicate standard and special installation procedures.

J. Installer's qualification statement.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
   2. Extra Flooring Material: 10 square yards (9 sq m) matching installed flooring.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

B. Deliver materials to project site in unopened containers clearly labeled with manufacturer's name and identification of contents.

C. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.

1.8 FIELD CONDITIONS

A. Maintain temperature in spaces to receive adhesively installed resilient flooring within range of 70 to 95 degrees F (21 to 35 degrees C) for not less than 48 hours before the beginning of installation and for not less than 48 hours after installation has been completed. Subsequently, do not allow temperature in installed spaces to drop below 50 degrees F (10 degrees C) or to go above 100 degrees F (38 degrees C).

PART 2 PRODUCTS

2.1 PREFORMED ATHLETIC FLOORING

A. All products by the same manufacturer.

B. Acceptable Manufacturers:
   1. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
      a. Burke Flooring: www.burkeflooring.com/#sle.
      b. Dinoflex Group: www.dinoflex.com/#sle.
      c. Grid: www.builtbygrid.com/#sle.
      d. LG Hausys America, Inc; : www.lghausysusa.com/#sle.
      e. No Fault Sport Group: www.nofault.com/#sle.
      f. Pawling Corporation: www.pawling.com/#sle.
      g. Robbins Sports Surfaces: www.robbinsfloor.com/#sle.
      h. Tarkett Sports: www.tarkettsportsindoor.com/#sle.
      i. Ultimate RB: www.ultimaterb.com/#sle.
      j. U.S. Rubber Recycling, Inc: www.usrubber.com/#sle.
   2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

C. Rubber Sheet Flooring (PRA-1-3): Recycled SBR (styrene butadiene rubber) and colored EPDM granules with urethane binder, lengths to avoid transverse seams.
   1. Thickness: Minimum 18 inches.
   2. Sheet Width: Minimum 48 inches (1220 mm).
   3. Tensile Strength: Minimum 150 psi (1.0 MPa), per ASTM D412.
   4. Color:
      a. PRA-1: RA1 Mellowed.
      b. PRA-2: 517 cloud.
      c. PRA-3: 507 Night.
   5. Products:
      a. Replay as manufactured by Tarkett.

2.2 ACCESSORIES

A. Flooring Adhesive: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates for conditions detrimental to installation of athletic flooring. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface

hardeners, and other chemicals that might interfere with bonding of athletic flooring to substrate.

3.2 PREPARATION

A. Remove coatings that are incompatible with flooring adhesives, using methods recommended by flooring manufacturer.

B. Broom clean areas to receive athletic flooring immediately before beginning installation.

3.3 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Resilient Sheet Flooring:
   1. Unroll flooring and allow to relax before beginning installation.
   2. Mix adhesive thoroughly and apply to substrate with notched trowel. Roll flooring into fresh adhesive, overlapping end seams and double cutting, butting factory edges and compression fitting.
   3. Roll entire flooring surface with steel roller to assure adhesion to substrate and eliminate air bubbles.
   4. Immediately remove any adhesive from flooring surface, using chemical recommended by flooring manufacturer.
   5. Weld seams using techniques and equipment recommended by manufacturer.
   6. Lay out game lines using tape and taping machine approved by flooring manufacturer. Apply game line paint with roller, and allow to dry before removing tape.
   7. Apply transparent top coat over flooring if recommended by manufacturer, to achieve a uniform finished appearance.

3.4 CLEANING

A. Clean flooring using methods recommended by manufacturer.

3.5 PROTECTION

A. Protect finished athletic flooring from construction traffic to ensure that it is without damage upon Date of Substantial Completion.

END OF SECTION 09 65 66

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SECTION 09 66 23.16 - EPOXY-RESIN TERRAZZO FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including, but not limited to, the following:
   1. Epoxy terrazzo with divider and accessory strips.
   2. Precast terrazzo units.

B. Related Sections:
   1. Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

A. {RSTEMP#222}

B. ASTM C131/C131M - Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine; 2020.

C. ASTM D56 - Standard Test Method for Flash Point by Tag Closed Cup Tester; 2021a.

D. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

F. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.

G. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics; 2023.

H. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer; 2016.

I. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems; 2020.

J. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine; 2017.

K. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

L. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

M. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019.

N. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 DEFINITIONS

A. NTMA: National Terrazzo and Mosaic Association, Inc.

1.5 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct a conference at project site before Terrazzo Contractor begins installation.
   1. The Contractor shall invite the Architect and representatives of the Owner.

2. Review methods and procedures related to terrazzo including, but not limited to, the following:
    a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
    b. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
    c. Review terrazzo mixes and patterns.
    d. Review custom terrazzo mixes, designs and patterns.
    e. Coordination with the work of other installers.

1.6 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Submit Product Data for each type of product required for installation including:
1. Strip materials.
2. Sealer.

C. Shop Drawings: Prepare and submit Shop Drawings that include plans, elevations, sections, component details and attachments to other work. Include terrazzo installation requirements. Show layout of the following:
1. Divider strips.
2. Expansion joint strips.
3. Accessory strips.
4. Abrasive strips.
5. Stair treads, risers and landings.
6. Terrazzo patterns.

D. Samples:
1. Prepare and submit a maximum of three samples, sizes 6 by 6 inches for each color and type of terrazzo specified.
2. Submit three samples, sizes for each color and type of precast terrazzo specified.

E. Samples for Initial Selection: Submit NTMA “Color Palette Brochure” showing full range of colors and patterns available for each terrazzo type.

F. Samples for Verification: Prepare and submit samples for each type, material, color and pattern of terrazzo and accessory required showing the full range of color, texture and pattern variations expected.
1. Terrazzo: 6 by 6 inches samples.
2. Accessories: 6 inch long samples of each type and kind of exposed strip item required.
3. Precast Terrazzo Units: Samples, 6 by 6 inches, sizes for each color and type of precast terrazzo specified.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: Submit two copies of qualification data.
1. Include list of projects indicating name and location of project, name of Owner, name and contact information for the Contractor, and name and contact information for Architect.
2. Include letter from NTMA with the name of the Project and name of member, stating current member status.

B. Material Certificates:
1. Epoxy Resin: For each type of resin required indicating that materials meet specification requirements, by manufacturer.
2. Aggregate: For each type of aggregate required indicating compatibility with terrazzo mix, signed by aggregate supplier.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Literature: Submit two copies of maintenance recommendations from NTMA.

1.9 QUALITY ASSURANCE

A. Epoxy Resin Manufacturer: An Associate Member of the NTMA, experienced in manufacturing epoxy resin in accordance with NTMA standards and with a record of successful in-service performance as well as sufficient production capacity to produce required materials.

B. Contractor: A Member of NTMA whose work has resulted in construction with a record of successful in-service performance.
   1. Installer shall have completed terrazzo installations within the past 5 years of scale and complexity similar to the proposed installation.

C. Source Limitations for Aggregates: Obtain each color, grade, type and variety of granular materials from sources with resources to provide materials of consistent quality in appearance and physical properties.

D. Mockups: Construct mockup, if required in bid or scope of work documents, to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup as indicated on Drawings.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to Project site in supplier's original wrappings and containers, labeled with source or manufacturer's name, material or product brand name, and lot number if any.

B. Materials shall be stored in their original, undamaged packages and containers, in a location where they will not be exposed to direct sunlight.
   1. Epoxy components shall be stored in a space where the ambient temperature can be maintained between 60 and 90 degrees F (15.6 and 32.2 degrees C) before use.

1.11 PROJECT CONDITIONS

A. The Contractor shall provide sufficient water, temporary heat and light, and adequate electric power with suitable outlets connected and distributed for use within 100 feet (30.1 m) of any working space.

B. The Contractor shall provide temporary enclosures and other suitable methods to protect adjacent spaces from damage during installation.
   1. Maintain ambient temperatures in the area to receive terrazzo at not less than 60 degrees F (15.6 degrees C).
   2. Maintain adequate ventilation in the area to receive terrazzo.

C. Terrazzo Contractor shall protect other adjacent work from water and dust generated by grinding operations.

1.12 WARRANTY

A. One year from date of substantial completion of terrazzo installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

C. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Accessibility:
      a. Texas Accessibility Standards (TAS).
   2. Building Code:
      a. Comply with applicable requirements of International Building Code ICC (IBC).
   3. Fire Code:
      a. Comply with applicable requirements of NFPA 1 Fire Code.

2.3 PERFORMANCE

A. Epoxy Resin:
   1. Test Specimens: Mix resin materials according to manufacturer's recommendation without aggregate added and cure for 7 days at 75 degrees F (24 degrees C) plus or minus 2 degrees and 50 percent plus / minus 2 percent relative humidity.
   2. Cured test specimens shall meet or exceed the following requirements:
      a. Hardness: 60 to 85 per ASTM D2240, Shore D.
      b. Minimum Tensile Strength: 3,000 psi (20.7 MPa) per ASTM D638 for a 2 inch (51 mm) specimen made using a “C” die per ASTM D412.
      c. Minimum Compressive Strength: 10,000 psi (68.9 MPa) per ASTM D695, Specimen B cylinder.
      d. Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D1308.
         1) Distilled water.
         2) Mineral water.
         3) Isopropanol.
         4) Ethanol.
         5) Soap solution at 1 percent.
         6) Sodium hydroxide at 10 percent solution.
         7) Hydrochloric acid at 10 percent solution.
         8) Hydrochloric acid at 30 percent solution.
         9) Detergent solution at 0.025.
         10) Acetic acid at 5 percent solution.

B. Epoxy Resin with Aggregate:
   1. Test Specimens:
      a. Mix epoxy resin according to manufacturer's recommendations and blend one volume of epoxy resin with 3 volumes of marble aggregate, consisting of:
         1) 60 percent No. 1 chip.
         2) 40 percent No. 0 chip.
      b. Grind and grout with epoxy resin finished to a nominal 1/4 inch (6 mm) thickness.
      c. Cure specimens 7 days at 75 degrees F (24 degrees C) plus / minus 2 deg. and 50 percent plus / minus 2 percent relative humidity.
   2. Cured epoxy terrazzo specimens shall nominally meet the following requirements:
      a. Flammability: Self-extinguishing, extent of burning 1/4 inch (6 mm) maximum according to ASTM D635.
      b. Coefficient of Linear Thermal Expansion: 0.0025 inch (0.06 mm) per degre F for temperature range of -12 to 140 degrees F (-24 to 60 degrees C) per ASTM D696.

C. Bond Strength of Epoxy Terrazzo: 300 lbf (1334 N) failure according to field test method for surface soundness and adhesion as described in ACI Committee No. 403 Bulletin.

2.4 MATERIALS

A. Epoxy Resin Matrix: Two-component, high solids product complying with specified performance requirements.
   1. Color: As required for mix indicated.

B. Primer: As recommended, manufactured and supplied by epoxy resin manufacturer.

C. Aggregates: Marble, glass, synthetic, and metal.
   1. Comply with NTMA gradation standards.
   2. Abrasion and Impact Resistance: Loss of 40 percent or less when tested according to ASTM C131/C131M (LA Abrasion).
   3. Aggregates shall contain no deleterious or foreign matter.

D. Divider Strips:
   1. Material: White alloy of zinc.
   2. Strip Thickness: 16 gauge.
   3. Type: “L” strip: 3/8 by 1/2 inch (10 by 13 mm).
   4. Heavy Top Thickness: 1/8 inch.

2.5 PRECAST TERRAZZO

A. Precast Terrazzo Base (ET-B): Minimum 3/8 inch (10 mm) thick, epoxy terrazzo units cast in maximum lengths possible, but not less than 36 inches (914 mm). Comply with precast manufacturer's written recommendations for fabricating precast terrazzo base units in sizes and profiles indicated.
   1. Type: As indicated.
   2. Top Edge: Straight, unfinished.
   3. Outside Corner Units: With finished returned edges or mitered at outside corner.
   4. Color, Pattern, and Finish: As selected by the Architect from full range of industry colors.

B. Precast Terrazzo Stair Units: Minimum 3/4 inch-thick terrazzo stair units. Comply with precast manufacturer’s written recommendations for fabricating precast terrazzo units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer. Finish exposed-to-view edges and reveals to match face finish. Ease exposed edges to 1/8 inch (3 mm) radius.
   1. Provide the following types of precast stair units:
      a. Stair treads (ET-T).
      b. Stair risers (ET-R).
      c. Stair landings (ET-L).
   2. Color, Pattern, and Finish: ET-1.

C. Setting Materials for Precast Terrazzo: One of the following acceptable to the manufacturer of precast terrazzo units.
   1. Latex-Portland Cement Mortar (Thin Set): {RS#222}.
   2. Epoxy Adhesive: Two component, compatible with terrazzo units and substrate.

2.6 MISCELLANEOUS ACCESSORIES

A. Sealer: Provide a non-ambering, clear sealer that is chemically neutral; does not impair terrazzo aesthetics or physical properties, and is recommended by terrazzo matrix manufacturer. Sealers shall comply with the following:
   1. Comply with requirements of authorities having jurisdiction.
   2. Comply with ASTM D2047.
   3. Water Based Sealer Properties: With pH factor between 7 and 10.
   4. Solvent Based Sealer Properties: Flashpoint at 80 degrees F (26.7 degrees C) or above according to ASTM D56.

B. Moisture Mitigation: Two-component, high solids, moisture tolerant, high density, low odor, epoxy-based product produced by epoxy terrazzo resin manufacturer specifically

recommended to reduce alkalinity levels and moisture emission to acceptable levels. If required, shall be an extra cost to others.

C. Crack Suppression/Isolation Membrane: As recommended, produced and supplied by approved terrazzo resin formulator, having minimum 120 percent elongation potential per ASTM D412. If required, shall be an extra cost to others.

2.7 MIXES

A. Terrazzo Selection: Terrazzo Contractor shall provide standard terrazzo mix(es) according to the following:
   1. NTMA Plate No. Insert NTMA color plate no..
   2. Mix Color: As selected by the Architect from NTMA color plates.
   3. Custom Mix Color and Pattern:
      a. Color No. 1 (ET-1):
         1) Epoxy Resin Color: insert manufacturer's designation.
         2) Chips: No. 1 insert grade of chip insert percentage percent.
         3) Chips: No. 1 insert grade of chip insert percentage percent.
         4) Chips: No. 1 insert grade of chip insert percentage percent.
      b. Color No. 2 (ET-2):
         1) Epoxy Resin Color: .
         2) Chips: No. 1 insert grade of chip insert percentage percent.
         3) Chips: No. 1 insert grade of chip insert percentage percent.
         4) Chips: No. 1 insert grade of chip insert percentage percent.
      c. Color No. 3 (ET-3):
         1) Epoxy Resin Color: insert manufacturer's designation.
         2) Chips: No. 1 insert grade of chip insert percentage percent.
         3) Chips: No. 1 insert grade of chip insert percentage percent.
         4) Chips: No. 1 insert grade of chip insert percentage percent.
      d. Color for Base:
         1) Epoxy Resin Color: insert manufacturer's designation.
         2) Chips: No. 1 insert grade of chip insert percentage percent.
         3) Chips: No. 1 insert grade of chip insert percentage percent.
         4) Chips: No. 1 insert grade of chip insert percentage percent.
   4. Custom Mix Color and Pattern: Match Architect's sample.

B. Proportions for Epoxy Terrazzo Topping: Comply with resin supplier’s recommendations.

C. Mixing of Terrazzo Topping: Mix epoxy components with aggregates in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.1 EXAMINATION

A. The Contractor and the Architect shall examine substrates and areas for compliance with requirements for installation tolerances and other conditions affecting performance of the work.
   1. Slab Flatness Tolerance: Subfloor is not to vary more than1/4 inch (6 mm) from true plane in a 10 feet (3 m) span.
   2. Cracks: Locate cracks and joints in concrete substrates. Verify location of control joints and expansion joints in epoxy terrazzo flooring.
      a. If required to prevent cracks in concrete substrates transmitting through epoxy terrazzo flooring, the Contractor shall make a written recommendation to install a crack suppression membrane and include specific recommendations on type and location.

B. The Contractor shall retain the services of an independent testing laboratory to verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to epoxy resin manufacturer's written instructions.

1. Perform relative humidity test using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
2. Perform anhydrous calcium chloride test, ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lbs. of water/1000 sq. ft. of slab area in 24 hours.
3. If required to prevent moisture vapor transmission in concrete substrates, the Terrazzo Contractor shall make a written recommendation to install moisture mitigation materials and include specific recommendations on type and location.

C. Correct non-conforming concrete substrates using materials compatible with epoxy terrazzo flooring system.
1. Materials used to correct nonconforming conditions must be compatible with the selected epoxy system and be approved by the manufacturer of epoxy resin materials and the Contractor.

D. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, cracking, excessive moisture vapor transmission, and alkalinity have been corrected.

3.2 PREPARATION

A. Broom clean area to receive terrazzo to remove loose chips and all foreign matter.

B. Mechanically abrade concrete surface.
1. Provide moisture mitigation materials according to instructions and recommendations of moisture mitigation materials manufacturer. Cost for moisture mitigation materials and installation shall be included as an Alternate.

C. Provide flexible epoxy crack isolation/suppression membrane: Cost for materials and installation for installation over not more than five percent of the floor area receiving epoxy terrazzo shall be included in the Base Bid. Cost for additional materials and installation for installation included as an Alternate.

3.3 POURED-IN-PLACE TERRAZZO INSTALLATION

A. Strip Materials: Terrazzo Contractor shall install strip materials as follows:
1. Divider and Control-Joint Strips:
a. Locate divider strips in locations indicated.
b. Install control joint strips back to back in locations indicated.
c. Install strips in epoxy adhesive without voids below strips.
d. Accessory Strips: Install as required to provide a complete installation.

B. Placing Terrazzo:
1. Prime subfloor in accordance with manufacturer's recommendations.
2. Proportion and thoroughly blend the materials.
3. Place mixture to achieve specified thickness.
4. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch (1.6 mm) higher than terrazzo surface.

C. Poured in Place Terrazzo Base: Provide mix color for terrazzo base to match approved sample.
1. The Contractor shall place and finish terrazzo base at the same time the terrazzo floor is being installed.

D. Poured in Place Terrazzo Stairs: Provide mix color for treads and risers to match main terrazzo field.
1. Place and finish terrazzo stair treads and risers at the same time the terrazzo floor is being installed.

E. Finishing: Finish the terrazzo topping as follows:
1. Rough Grinding:
a. Grind with 24 or finer grit stones or with comparable diamond abrasives.
b. Follow initial grind with 60/80 grit stones or with comparable diamond abrasives.
2. Grouting:

a. Clean terrazzo with clean water and rinse. Allow to dry.
b. Apply epoxy grout per manufacturer's instructions.
c. Allow grout to cure.

3. Fine Grinding/Polishing: Grind with 120 grit or with comparable diamond abrasives until all grout is removed from surface.

F. Terrazzo Cleaning: Clean finished terrazzo as follows:
1. Remove grinding residue from terrazzo surface.
2. Wash terrazzo surfaces immediately after final grinding of terrazzo flooring with water and allow surfaces to dry thoroughly.

G. Sealing: Seal terrazzo according to sealer manufacturer’s written instructions.

3.4 PRECAST TERRAZZO INSTALLATION

A. Terrazzo Contractor shall install precast terrazzo units as follows:

B. Precast Terrazzo Base: Use latex-portland cement motar or epoxy adhesive to install precast terrazzo base over substrates indicated according to ANSI 108.5 or ANSI 108.6.

C. Precast Terrazzo Stair Units: Use latex-portland cement motar or epoxy adhesive to install treads, risers, and landings over concrete substrates according to ANSI 108.5 or ANSI 108.6.

D. Precast Terrazzo Stair Units: Use epoxy adhesive to install treads, risers, and landings over steel substrates according to ANSI 108.6.

3.5 REPAIR

A. Terrazzo Contractor shall repair terrazzo areas that evidence lack of bond between topping and underbed according to NTMA’s written recommendations.

3.6 PROTECTION

A. After application of the sealer, the Work shall be ready for final inspection and acceptance by the Owner or his agent.

B. Protect the finished floor after completion of final grinding and applied sealer to terrazzo surfaces.

END OF SECTION 09 66 23.16

SECTION 09 67 00 - FLUID-APPLIED FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Accessories necessary for a complete installation.

B. Related Sections:
   1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

A. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings; 2018.

B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

C. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

D. ASTM D2369 - Standard Test Method for Volatile Content of Coatings; 2020.

E. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2024).

F. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser; 2019.

G. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).

H. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.

I. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

J. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

K. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.4 DEFINITIONS

A. Refer to Section 01 42 16 - Definitions for the following terms:
   1. Comparable Product.

1.5 SUBMITTALS

A. Product Data: Technical data for each type of product indicated include manufacturer's technical data, application instructions, and recommendations for each flooring component required.

B. Samples: Submit flooring system required, 6 inches (150 mm) square, applied to a rigid backing.
   1. Two samples indicating range of slip resistant textures
   2. Two samples of actual color and texture selected by Architect.

C. Reports and Certificates:

1. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

D. Maintenance Data: Submit data for flooring system to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements of the IBC for interior floors.
   2. Fire Test Response Characteristics: Determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
   3. Accessibility Requirements: Comply with applicable requirements.
   4. Flammability: Self-extinguishing according to ASTM D635.

B. Installer Qualifications: Installer having minimum 5 years documented experience in the installation of epoxy floors and who is a manufacturer authorized representative trained and approved for installation of flooring systems required. Engage installer certified in writing by floor manufacturer as qualified to apply flooring systems indicated.

C. Source Limitations: Obtain primary flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

D. Pre-Installation Conference: Conduct conference at site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during flooring application and for 24 hours after application unless manufacturer recommends a longer period.

1.9 WARRANTY

A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full year from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. BASF Corporation: construction.basf.com.
   2. Crossfield Products Corp.: www.crossfieldproducts.com.
   3. Sherwin-Williams Company (The), High Performance Flooring: industrial.sherwin-williams.com/na/us/en/resin-flooring.html.
   4. Sika Corporation; Flooring: https://usa.sika.com/en/construction/floor-wall/flooring-systems.html.
   5. Stonhard Group (The): www.stonhard.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 FLUID-APPLIED, EPOXY RESIN FLOORING SYSTEM (FF-1)

A. Basis of Design Product:
   1. Liquid Elements manufactured by Stonhard, Inc.

B. System Characteristics:
   1. Color: As selected by the Architect from manufacturer's full line.
   2. Pattern: As indicated on Drawings.
   3. Wearing Surface: Medium.
   4. Integral Cove Base: As indicated on Drawings.
   5. Overall System Thickness: 2 mm.

C. System Components: Manufacturer's standard components that are compatible with each other and as follows:
   1. Primer:
      a. Material Basis:Stondri MVT epoxy primer.
      b. Resin: Epoxy.
      c. Formulation Description: 2 component, high solids, moisture suppressant.
      d. Application Method: Rubber squeegee back roll.
      e. Number of Coats: One.
   2. Undercoat:
      a. Material Basis: Epoxy undercoat HT4.
      b. Resin: Epoxy.
      c. Formulation Description: 2 component, 100% solids.
      d. Type: Pigmented.
      e. Number of coats: One.
   3. Grout Coat:
      a. Material Basis: Stonblend Groutcoat
      b. Resin: Epoxy.
      c. Formulation Description: 2 component, 100% high solids.
      d. Type: Clear.
      e. Finish: Standard.
      f. Number of Coats: One.
   4. Base System:
      a. Material Basis: Reflect.
      b. Resin: Epoxy
      c. Type: Pigmented.
      d. Finish: Gloss.
      e. Number of Coats: One.
   5. Topcoat:
      a. Material Basis: Stonseal CF7.
      b. Resin: VOC EPA Compliant, Waterborne, Aliphatic Polyurethane.
      c. Formulation Description: 2 component 100% high solids.
      d. Type: Clear.

e. Finish: Matte.
f. Number of Coats: Two.

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
1. Tensile Strength: 800 psi per ASTM C307.
2. Hardness: 80 to 85, Shore D per ASTM D2240.
3. Impact Resistance: > 110 in. lbs. per ASTM D2794.
4. Indentation Resistance:32% Indentation/ 0% Residual Indentation.
5. VOC Content:
a. Undercoat: 58 g/L.
b. Self-Levelers: 15 g/L.
6. Cure Rate: 12 hours for foot traffic, 24 hours normal operations.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Remove existing floor covering, adhesives, and contaminates. Ensure existing concrete floor is ready to receive epoxy floor covering.
2. Roughen concrete by Shot Blasting (mechanical preparation only) substrates complying with manufacturer's written instructions.
3. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
4. Verify that concrete substrates are dry and moisture vapor emissions are within acceptable levels according to manufacturer's written instructions.
a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1,000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.
b. Plastic Sheet Test: ASTM D4263. Proceed with application after testing indicates absence of moisture in substrates.
c. Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
5. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

D. Epoxy Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 APPLICATION

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Primer/Waterproofing Membrane: Apply primer or waterproofing membrane over entire substrate surface in manufacturer's recommended thickness.
   1. Apply to integral cove base substrates.

C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Do not broadcast into cove. Mix quartz aggregates and add thixotropic and hand trowel. Round internal and external corners.

D. Quartz Granules: Broadcast Quartz into Undercoat. Scrape off and vacuum up excess aggregate.

E. Topcoats: Trowel or squeegee apply clear epoxy resin coat topcoats indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

3.3 CURING

A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 48 hours.

3.4 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

3.5 CLEANING

A. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

END OF SECTION 09 67 00

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SECTION 09 68 00 - CARPETING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements including but not limited to:
   1. Sheet Carpeting
   2. Accessories necessary for a complete installation.

B. Related Sections:
   1. Section 03 30 00 - Cast-in-Place Concrete.
   2. Section 09 65 13 - Resilient Base and Accessories.

1.3 REFERENCE STANDARDS

A. AATCC Test Method 134 - Test Method for Electrostatic Propensity of Carpets; 2019.

B. AATCC Test Method 174 - Antimicrobial Activity Assessment of New Carpets; 2022, with Editorial Revision (2023).

C. AATCC TM 165 - Test Method for Colorfastness to Crocking: Textile Floor Coverings—Crockmeter; 2021.

D. AATCC TM16.1 - Test Method for Colorfastness to Light: Outdoor; 2023.

E. AATCC TM16.2 - Test Method for Colorfastness to Light: Carbon-Arc; 2023.

F. AATCC TM16.3 - Test Method for Colorfastness to Light: Xenon-Arc; 2020.

G. ASTM D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings; 2021.

H. ASTM D2646 - Standard Guide for Backing Fabric Characteristics of Pile Yarn Floor Coverings; 2018.

I. ASTM D3936 - Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering; 2021.

J. ASTM D7330 - Standard Test Method for Assessment of Surface Appearance Change in Pile Floor Coverings Using Standard Reference Scales; 2022.

K. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.

L. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

M. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

N. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

O. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

P. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.4 SUBMITTALS

A. Product Data - Technical data including installation recommendations for each type of substrate:
   1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.

B. Samples:
   1. For each product, each color, and texture required, provide a sample as follows. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules:
      a. Carpet: 12 inch (300 mm) square Sample from approved color and product of carpet.
      b. Carpet Seam: 6 inch (150 mm) Sample.
      c. Mitered Carpet Border Seam: 12 inch (300 mm) square Sample. Show carpet pattern alignment.
      d. Carpet accessory samples.

C. Product Test Reports: For carpet and carpet cushion, for tests performed by a qualified testing agency.

D. Shop Drawings: Showing extent of product, seam direction, and location and type of carpet accessories. Submittal to indicate columns, doorways, enclosing walls or partitions, casework, and locations where cutouts are required.

E. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
   1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
   2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Fire Test Response Characteristics: Provide products with the critical radiant flux classification determined by testing identical products in accordance with ASTM E648.
   2. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
   3. Accessibility Requirements: Comply with applicable requirements:
   4. AQMD: Air Quality Management District, Local Regulations.
   5. SCAQMD: South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications.
   6. CRI: Carpet and Rug Institute Green Label Plus.

B. Installer Qualifications: Installer having minimum 5 years’ documented experience as a commercial carpet installer, who is certified by the International Certified Floorcovering Installers Association at the Commercial II or higher certification level.

C. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.

D. Pre-installation Conference:
   1. Refer to Section 01 31 00 - Project Management and Coordination.

1.6 WARRANTY

A. Written warranty in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period:
   1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excessive surface wear, excess static discharge, and delamination.
   3. Warranty Period: 25 years from date of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

B. Store in a dry location between 65 degrees F and 90 degrees F and a relative humidity below 65%. Protect from damage and soiling. Stack carpet rolls horizontally, elevated above slab level on a flat surface, stacked no higher than two rolls.

C. Store materials in area of installation for minimum period of 48 hours prior to installation.

D. Protect carpet from damage, dirt, stains, and moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Bentley Mills: www.bentleymills.com.
2. Interface, Inc.: www.inferface.com.
3. Mannington Commercial, a part of Mannington Mills, Inc.: www.manningtoncommercial.com.
4. Milliken: www.milliken.com.
5. Mohawk Industries: www.mohawkflooring.com..
6. Patcraft: www.patcraft.com.
7. ShawContract, part of Shaw Industries Group, Inc., a Berkshire Hathaway Company: www.shawcontract.com.
8. Tarkett: commercial.tarkett.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 CARPET, GENERAL

A. Performance:
1. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
4. Delamination: Not less than 4 lbf/in. (18 N/mm) per ASTM D3936.
5. Tuft Bind: Not less than 5 lbf (22 N) according to ASTM D1335.
6. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC TM 165.
7. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC TM16.1, AATCC TM16.2, and AATCC TM16.3.
8. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC Test Method 174.
9. Electrostatic Propensity: Less than 3.5 kV according to AATCC Test Method 134.
10. Emissions: Provide carpet that complies with testing and product requirements of CRI Green Label Plus.
11. Backing: Standard with manufacturer.

B. Face Construction:
1. Size: Refer to carpet type.
2. Construction: Refer to Basis of Design product for minimum criteria.

C. Backing:
1. As recommended by manufacturer.
2. Adhesive System: As recommended by manufacturer.
3. Applied Soil Resistance Treatment: Manufactuer's standard.
4. Antimicrobial Treatment: Manufacturer's standard.

2.3 SHEET CARPET

A. Sheet Carpeting, Type CP-3 - Walk-Off:
   1. Basis of Design: Products manufactured by Tarkett .
      a. Collection: Assertive Action.
      b. Color: 26202 - Steelwork.
   2. Size: Roll.

2.4 ACCESSORIES

A. Adhesives: Water resistant, mildew resistant, nonstaining, pressure sensitive type to suit products and subfloor conditions indicated, complying with flammability requirements for installed carpet and is recommended by carpet manufacturer for releasable installation.

B. Trowelable Leveling and Patching Compounds: Latex modified, hydraulic cement based formulation provided or recommended by carpet cushion manufacturer.

C. Adhesives: Water resistant, mildew resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet and carpet cushion manufacturers.

D. Seam Adhesive: Hot melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

E. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints and provide accessible transitions. (11B-302)

F. Extra Carpet: After completion of the carpet installation, the carpet subcontractor shall provide an additional three (3) percent of total yards installed of each carpet specified to the Owner for future carpet replacement that may be required. This extra stock is to be unused rolls, tiles, and mats and does not include scraps.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet and carpet cushion until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet and carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

3.2 COORDINATION

A. Contractor’s responsibility to hire movers to move furniture as required for flooring installation. Coordinate with Owner and Architect regarding temporary furniture relocation.

3.3 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:
   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond.

2. Prior to delivery of flooring materials, contractor shall conduct Calcium Chloride “dome” test to verify that concrete floors are dry with maximum moisture vapor emissions of 3 lbs. per 1000 square feet. in 24 hours, and exhibit negative alkalinity, carbonation or dusting. Apply moisture test in four different areas of each floor location with at least one test for each 1,000 square feet of floor area.
3. Prior to delivery of carpeting, conduct Relative Humidity Test Method in accordance with ASTM F2170 using a Wagner Rapid RH probe to verify relative humidity and surface pH of concrete floor slabs, the method:
    a. Requires drilling holes at diameter not to exceed outside diameter of probe by more than 0.04 inch to depth equal to 40 percent of slab's thickness (elevated structural slab shall be tested at depth equal to 20 percent of slab thickness).
    b. Place probe to full depth of test hole, place cap over probe.
    c. Permit test site to acclimate, or equilibrate, for 72 hours prior to taking relative humidity readings.
    d. Remove cap and press button on the probe to obtain reading.
    e. Relative humidity readings for substrates receiving non-permeable flooring are 75% or lower.
4. Testing shall require 3 tests in first 1,000 square feet, with one additional test per each additional 1,000 square feet of concrete slab surface.
5. Alkalinity Testing: Concrete floors shall be tested for alkalinity prior to installation of flooring. Levels of pH shall not exceed written recommendations of flooring manufacturer or adhesive manufacturer, or both.
6. Delivery of flooring materials and beginning of installation means acceptance of existing substrate and site conditions.
7. Subfloor finishes comply with requirements specified in Section 03 30 00 - Cast-In-Place Concrete for slabs receiving carpet.
8. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
9. Install Vapor Emission Treatment Systems where tests reveal presence of more than acceptable moisture level in accordance with Test Method ASTM F1869 or ASTM F2170.

C. Proceed with installation after correcting unsatisfactory conditions.

3.4 PREPARATION

A. Comply with CRI 104, Section 7.3 Site Conditions; Floor Preparation and with carpet manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet and cushion manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.5 INSTALLATION

A. Comply with CRI 104 and carpet and carpet cushion manufacturer written installation instructions for the following:
    1. Direct Glue Down Installation: Comply with CRI 104, Section 9 Direct Glue Down Installation.
    2. Stair Installation: Comply with CRI 104, Section 13 Carpet on Stairs for glue down installation.

B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position:

1. Do not bridge building expansion joints with carpet.
2. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
3. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

C. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

D. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, Patterned Carpet Installations and with carpet manufacturer's written recommendations.

3.6 CLEANING AND PROTECTING

A. Perform cleaning operations immediately after installing carpet:
1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face beater element.

B. Protect installed carpet to comply with CRI 104, Section 16, Protecting Indoor Installations.

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion manufacturer

END OF SECTION 09 68 00

SECTION 09 84 00 - ACOUSTIC ROOM COMPONENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Fabric-covered acoustic room components.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications: Miscellaneous metal supports.

1.3 REFERENCES

A. ASTM C365/C365M - Standard Test Method for Flatwise Compressive Properties of Sandwich Cores; 2022.

B. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.

C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

F. ASTM E1111/E1111M - Standard Test Method for Measuring the Interzone Attenuation of Open Office Components; 2014 (Reapproved 2022).

G. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturer’s specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer’s installation instructions.

B. Shop Drawings: Show panel joints, detail references, dimensions and methods of attachment.

C. Samples: 12 inch x 12 inch sample of actual material and color charts showing manufacturer's full range of colors for Architect’s selection.

1.5 QUALITY ASSURANCE

A. Provide acoustical panels, diffusers and fabrics of each type required from one (1) manufacturer, of uniform texture and color.

B. Installer. Provide evidence of appropriate experience in system installation and that installation method proposed is acceptable to panel manufacturer.

C. Single Source Responsibility: Obtain acoustical panel materials from a single manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Carefully protect work during shipment, storage and installation.

B. Deliver materials to job site and store elevated above floor in an enclosed space with proper ventilation and protection from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Acoustical Panels:
      a. Acoustical Resources, Inc.
      b. Armstrong World Industries.
      c. Autex Acoustics.
      d. AVL Systems, Inc.
      e. Benton Brothers Solutions, Inc.
      f. Conwed Designscapes.
      g. Decoustics.
      h. Finelite, Inc.: www.finelite.com,
      i. Golterman & Sabo, Inc.
      j. Kirei USA, LLC.
      k. Lamvin, Inc.
      l. MBI Products Company.
      m. Rockfon.
      n. Sky Acoustics.
      o. Sound Concepts.
      p. Wall Technology, Inc.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Code Standards:
      a. Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.

2.3 MATERIALS

A. Fabric-Faced Acoustical Room Components:
   1. Acoustical Room Component Type 1 (ARC-1,2 & 3): All panels over 7 feet-0 inches above finished floor.
      a. Basis of Design Product/Manufacturer: Shapes Wall Tiles as manufactured by Acoufelt.
      b. Type: Absorber Panels.
      c. Core Composition: 6-7 PCF medium density single glass fiber core.
      d. Flame Spread: Class A, 25 or less.
      e. Shape: Hexagon.
      f. Panel Edge Profile: Square, chemically hardened.
      g. Size: Large.
      h. Thickness: 1 inches.
      i. Color:
         1) ARC-1: Refer to Drawings.
         2) ARC-2: GR02 Grey.
         3) ARC-3: CH01 Charcoal.
   2. Acoustical Room Component Type 4 (ARC-4): Barrel Shaped Diffuser
      a. Basis of Design: "Barrel Diffuser" manufactured by Acoustical Resources, Inc.

b. Type: Diffuser Type Barrel with internal liner.
c. Description: Glass fiber mat core saturated with fire retardant polyester resin molded into one piece barrel shape with internal concave surface of dense fire retardant non-acoustical liner.
d. Sizes: 48 inches x 48 inches, unless shown otherwise. Thickness shall be as recommended by manufacturer to suit application.
e. Composite NRC: 0.05.
f. Fabric Facing: 100 percent polyester fabric, Guilford of Maine FR701-2100 Series in colors to be selected by Architect from manufacturer's full range of colors, or approved equal. Finish shall be applied directly to face and edges of the panel and returned onto the back of the panel to provide a full finished edge. All corners shall be fully tailored.
g. Mounting: Concealed mechanical clips at top and hook & loop bottom shall be shimmed on stacked spacer panels to provide even face alignment as instructed by manufacturer.
h. Flame Spread: Class A, 25 or less in accordance with ASTM E84.

3. Fabric Facing: 100 percent polyester fabric, Guilford of Maine Anchorage - 2335 Series in colors selected by Architect from manufacturer's full range of colors, or approved equal. Finish shall be applied directly to face and edges of the panel and returned onto the back of the panel to provide a full finished edge. All corners shall be fully tailored.
4. Mounting Accessories:
   a. Top Clips and Brackets:
      1) Factory mounted concealed mechanical “Z” clips screw fastened to the back of resin hardened spots on panel at maximum 24 inch on center spacing.
      2) Set clips inboard one (1) to two (2) inches from panel edges.
      3) “Z” clips shall engage on galvanized single or double wall brackets with closed ends to prevent lateral panel movement.
      4) Clips shall be fabric covered if exposed to view.
   b. Bottom: 6 inch hook & loop brackets shall be shimmed on stacked spacer panels to provide even face alignment.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify dimensions to insure proper fabrication of materials.

3.2 INSTALLATION

A. Install wall panels, ceiling diffusers, and fabrics only after all wet work has been completed and temperature conditions approximate conditions when space will be occupied.

B. Install wall panels, ceiling diffusers, and fabrics in accordance with manufacturer's instructions and approved shop drawings.

C. Install Tectum Wall Panels on Natatorium walls with venting space between the wall and panels in accordance with manufacturer’s instructions.

D. Install wall panels, and ceiling diffusers in proper alignment. Shim wall track as necessary to provide a level frame work.

E. Arrange wall panels symmetrically on each wall, unless otherwise indicated, Remove wall panels, ceiling diffusers, and fabrics are damaged and unacceptable to Architect and replace with new undamaged materials at no expense to Owner.

END OF SECTION 09 84 00

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SECTION 09 90 00 - PAINTING AND COATING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Surface preparation and field painting of exposed items and surfaces.
   2. Field preparation and painting of factory primed metal products and fabrications.
   3. Accessories necessary for a complete installation.

B. Related Sections:
   1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2019.

C. ASTM D2486 - Standard Test Methods for Scrub Resistance of Wall Paints; 2017.

D. ASTM D2805 - Standard Test Method for Hiding Power of Paints by Reflectometry; 2011 (Reapproved 2018).

E. ASTM D4828 - Standard Test Methods for Practical Washability of Organic Coatings; 1994.

F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

H. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

I. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

J. SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals; 2020.

1.4 DEFINITIONS

A. Standard coating terms defined in ASTM D16 apply.
   1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
   2. Eggshell refers to low sheen finish with a gloss range between 20 and 35 when measured at a 60 degree meter.
   3. Semi-gloss refers to medium sheen finish with a gloss range between 35 and 70 when measured at a 60 degree meter.
   4. Gloss refers to high sheen finish with a gloss range more than 70 when measured at a 60 degree meter.

1.5 SUBMITTALS

A. Product Data: Submit technical data and information for block fillers, primers, paints, and coatings, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
   1. Indicate manufacturer's instructions for special surface preparation procedures, substrate conditions requiring special attention.

2. Material List: Provide inclusive list of required coating materials. Indicate each material and cross reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number, series, and general classification.

B. Samples: Submit for each type of paint system and in each color and gloss of topcoat.
   1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
   2. Provide list of material and application for each coat of each sample. Label each sample as to location and application.
   3. Submit samples on following substrates for review of color and texture only:
      a. Concrete: Provide two 4 inch square samples for each color and finish.
      b. Concrete Masonry: Provide two 4 inch x 8 inch samples of masonry, with mortar joint in the center, for each finish and color.
      c. Painted Wood: Provide two 12 inch square samples of each color and material on hardboard.
      d. Ferrous and Nonferrous Metals: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.

C. Product List: Submit list of including each paint system, color, and location of application. Use same product and location designations indicated in Finish Schedule.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with Federal and local toxicity and air quality regulations and with Federal requirements on content of for heavy metals including but not limited to: lead and mercury. Do not use solvents in paint products that contribute to air pollution.
   2. Performance and Durability:
      a. ASTM D16 Standard Terminology for Paint, Related Coatings, Materials, and Applications.
      b. ASTM D2486 Standard Test Method for Scrub Resistance of Interior Wall Paint.
      c. ASTM D2805 Standard Test Method for Hiding Power of Paints by Reflectometry.
      d. ASTM D4828 Standard Test Method for Practical Washability of Organic Coatings.

B. Applicator Qualifications: A firm or individual having minimum 5 years documented experience in applying paints and coatings similar in material, design, and extent to those indicated.

C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.

C. Paint Materials: Store at a minimum of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

D. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

1.8 FIELD CONDITIONS

A. Apply waterborne paints when temperatures of surfaces to be painted and surrounding air are between 50 degrees F and 90 degrees F (10 degrees and 32 degrees C).

B. Do not thin or add water to waterbased paints, including waterbased alkyds.

C. Weather Conditions:
   1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

2. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F (3 degrees C) above dew point; or to damp or wet surfaces.
3. Minimum Application Temperatures for Water based Paints: Between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).

D. Apply solvent thinned paints when temperatures of surfaces to be painted and surrounding air are between 45 degrees F. and 95 degrees F (7 degrees F and 35 degrees C).
1. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
2. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

E. Provide lighting level of 80 foot candles (860 lux) measured midheight at substrate surface.

F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual, other code required labels, or equipment name, identification, performance rating, or nomenclature plates.

1.9 WARRANTY

A. Written warranty signed by the manufacturer and the installer in which the manufacture and installer agree to repair or replace paint and primers that fail within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Flaking or delamination of paint with the substrate.
b. Rust, scale, similar imperfections due to improper surface preparation.
c. Thinning or watering of paint beyond that considered acceptable of paint manufacturer.
d. Failure to achieve dry film thickness (DFT) recommended by manufacturer for each coat in a paint system.
e. Deterioration or loss of color of paint beyond normal weathering.
2. Warranty Period: One year from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 2 percent, but not less than 1 gallon (3.8 L) of each material and color applied.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Benjamin Moore & Co.: www.benjaminmoore.com.
2. Dulux, an AkoNobel company: www.dulux.co.uk.
3. Dunn-Edwards Corporation: www.dunnedwards.com.
4. The Sherwin-Williams Company: www.sherwin-williams.com.
5. Vista Paint Corporation: www.vistapaint.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

A. Basis of Specifications: The Sherwin-Williams Company.

B. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.

C. Proprietary Names: Paint Schedule is based on a single manufacturer for convenience. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that named products are required to the exclusion of comparable products of specified manufacturers. Furnish product technical data, including percent solids by weight and volume; VOC content limits and emissions data; and certificates of performance for comparable paint products of specified manufacturer.

D. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.

E. Material Compatibility: Provide each paint system including block fillers, primers, and finish coats, that are compatible with one another and with substrates indicated under conditions of service and application, demonstrated by manufacturer based on testing and field experience.

F. Material Quality: Provide manufacturer's best quality commercial paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint material containers not displaying manufacturer's product identification will not be acceptable. Residential quality paint products are not permitted.

G. Chemical Components of Interior Paints and Coatings: Provide products complying with limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and SCAQMD 1113.
   1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
   2. Restricted Components: Paints and coatings shall not contain components restricted by the EPA and SCAQMD 1113.

H. Materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

I. Patching Materials: Latex filler compatible with paint systems.

J. Fastener Head Cover Materials: Latex filler.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke to engage the services of a qualified testing agency to sample paint materials.
   1. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to site, samples may be taken at the site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

2.4 PAINT COLOR SCHEDULE

A. Colors (P-#):
   1. P-1 - Typical Ceilings and Soffits:
      a. Manufacturer: The Sherwin-Williams Company.
      b. Color: SW 7014 Eider White.
      c. Sheen: Eggshell.
      d. Locations: All gypsum board ceilings and soffits unless noted otherwise.
   2. P-2 - :
      a. Manufacturer: The Sherwin-Williams Company.
      b. Color: SW 7066 Gray Matters.

c. Sheen: Eggshell.
d. Locations: As indicated on Drawings.

3. P-3 - :
   a. Manufacturer: The Sherwin-Williams Company.
   b. Color: SW 7068 Grizzle Gray.
   c. Sheen: As selected by Architect.
   d. Locations: As indicated on Drawings.
4. P-4 - :
   a. Manufacturer: The Sherwin-Williams Company.
   b. Color: Branding Gold, As selected by Architect.
   c. Sheen: As selected by Architect.
   d. Locations: As indicated on Drawings.
5. P-5 - :
   a. Manufacturer: The Sherwin-Williams Company.
   b. Color: SW6991 Black Magic.
   c. Sheen: Egg Shell.
   d. Locations: As indicated on Drawings.
6. P-6 - :
   a. Manufacturer: The Sherwin-Williams Company.
   b. Color: SW 7014 Eider White.
   c. Sheen:Epoxy.
   d. Locations: All CMU Walls, Unless noted otherwise.
7. P-7 - :
   a. Manufacturer: The Sherwin-Williams Company.
   b. Color: SW 7066 Gray Matters.
   c. Sheen: Epoxy.
   d. Locations: As indicated on Drawings.
8. P-8 - :
   a. Manufacturer: Benjamin Moore & Co.
   b. Color: Branding Gold, As selected by Architect.
   c. Sheen: Epoxy.
   d. Locations: As indicated on Drawings.
9. P-9 - :
   a. Manufacturer: The Sherwin-Williams Company.
   b. Color: SW6991 Black Magic.
   c. Sheen: Epoxy.
   d. Locations: As indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for maximum moisture content and conditions affecting performance of the work.

B. Test substrates after repairing and cleaning substrates but prior to application of paint and coatings.
   1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
      a. Concrete: 12 percent.
      b. Fiber Cement Board: 12 percent.
      c. Masonry (Clay and CMUs): 12 percent.
      d. Wood: 15 percent.
      e. Gypsum Board: 12 percent.
      f. Plaster: 12 percent.

2. Test cementitious and plaster cement/stucco for alkalinity (pH).

C. Gypsum Board Substrates: Verify taped joints are tapes and finishing compound is sanded smooth.

D. Plaster Substrates: Verify plaster has fully cured. Verify existing plaster is in good condition and can receive new paint coating.

E. Spray Textured Ceiling Substrates: Verify surfaces are dry.

F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
   1. Verify previously painted surfaces can be stripped to bare substrate, repaired if necessary, and prepared to receive new paint system consisting of primer and two top coats at a minimum.
      a. Note: Previously painted surfaces have failed to accept new paint systems. Determined cause of failure and take corrective measures to ensure each surface accepts new paint system. Failure of new paint system is not permitted.

G. Commence paint and coating application after correcting unsatisfactory conditions and surfaces are dry. Application of coating indicates applicator’s acceptance of surfaces and conditions.

3.2 ITEMS TO RECEIVE PAINT

A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
   1. All ferrous metal.
   2. All exterior galvanized metal.
   3. All exterior wood.
   4. All interior wood.
   5. All prime coated hardware.
   6. All exposed pipe, plumbing, ductwork, conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
   7. All metal grilles, except aluminum, unless otherwise indicated.
   8. All exposed gypsum board surfaces, including all mechanical rooms.
   9. Miscellaneous other items which normally require painting or are scheduled to be painted.
   10. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
   11. All exposed mechanical equipment and electrical equipment.
   12. Traffic lanes and parking spaces including fire lanes and crosswalks.
   13. Rolling doors.
   14. Bollards.
   15. Loose lintels.
   16. Refer to MEP specifications for additional items to receive paint.

B. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

3.3 PREPARATION

A. Coordination of Work: Review work in which primers are provided to ensure compatibility of the total system for various substrates. Notify Architect of anticipated problems when using materials specified over substrates primed by others.

1. Pre-Primed Substrates: Inspect existing conditions in which primers are factory applied to ensure compatibility of the total system for each substrate. Notify Architect of anticipated problems when using the materials specified over factory primed or pre-primed substrates.
2. Existing Painted Surfaces: Inspect previously painted surfaces to ensure compatibility of the existing paints with new paint system for each substrate. Notify Architect of anticipated problems.
3. Correct defects and clean surfaces affecting bond with paint system. Remove existing paints exhibiting loose surface defects showing signs of rust, scale, or delamination.
4. Seal marks which may bleed through surface finishes.

B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting.
1. Remove hardware and hardware accessories, plates, lighting fixtures, and similar items that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface applied protection if any.
3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
4. Clean and prepare surfaces to receive paint according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers, existing paint or coating, or remove and reprime.
5. Correct defects and clean surfaces affecting bond with paint or coating system. Remove existing coatings exhibiting loose surface defects. Seal marks which may bleed through surface finishes.

C. Cleaning: Before applying paint or surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and contaminants from the cleaning process will not fall on wet, newly painted surfaces.
1. Remove incompatible primers, including factory applied primers, and reprime substrate with compatible primers or apply barrier coat as necessary to produce paint systems indicated.
2. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
3. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
4. Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
5. Aluminum Substrates: Remove surface oxidation.

D. Mildew and Mold Removal: Remove mildew and mold by high power washing (pressure range of 1500 to 4000 psi) with solution of trisodium phosphate and bleach. If substrate is too soft for high power washing, scrub substrate with solution. Rinse with clean water and allow surface to dry.

E. Protective Coverings: Provide protections for duration of the work, including covering furnishings and decorative items. Protect and mask adjacent finishes and components against damage, marking, overpainting, and injury. Clean and repair or replace damage caused by painting.

F. Renovated Surfaces: Clean surface free of loose dirt and dust. Except at gypsum board surfaces, remove existing paint and coatings to bare substrate and prepare substrates to receive new paint system. Test substrate to verify it will bond with primer and receive new paint system without failure. If test fails, clean surface to base substrate and apply barrier coat. Retest to verify surface will accept new paint system.
   1. Remove surface film preventing proper adhesion and bond.
   2. Wash glossy paint with a solution of sal soda and rinse thoroughly.
   3. Remove loose, blistered, and defective paint and varnish; smooth edges with sandpaper.
   4. Clean corroded iron and steel surfaces.
   5. Repair and blend into portland cement plaster.
   6. Prime bare surfaces.
   7. Tone varnished surfaces with stain bringing to uniform color.
   8. If existing surfaces cannot be put in acceptable condition for finishing by customary cleaning, sanding, and puttying operations, notify Owner and do not proceed until correcting unsatisfactory conditions.

G. Cementitious Substrates: Prepare concrete surfaces to receive paint. Remove efflorescence, chalk, dust, dirt, grease, oils, release agents, mold, mildew, and existing paint. Roughen as necessary to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
   1. Use abrasive blast cleaning methods if recommended by paint manufacturer.
   2. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions.
      a. Determine alkalinity and moisture content of surfaces by performing appropriate pH testing. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct condition prior to application of paint.
      b. Anhydrous Calcium Chloride Test:ASTM F1869 . Proceed with installation after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.3 kg of water/92.9 sq. m).
      c. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation after substrates have obtained percent relative humidity level recommended by paint manufacturer.
      d. Perform additional moisture tests when recommended by manufacturer. Proceed with installation when moisture content complies with that permitted in manufacturer's written instructions.
      e. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to thoroughly dry.
   3. Clean concrete floors to receive paint or coating with a 5 percent solution of muriatic acid or etching cleaner. Flush floors with clean water to remove acid; neutralize with ammonia, rinse, allow to dry; vacuum before painting.

H. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
   1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
   2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

I. Galvanized Ferrous Metal Substrates: Clean galvanized surfaces with nonpetroleum based solvents leaving surface free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

J. Shop Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop primed surfaces.

K. Aluminum Substrates: Clean surfaces to remove oil, grease, surface oxidation, and contaminants in accordance with SSPC SP-1 Solvent Cleaning. Lightly abrade surface with a nonmetallic pad.

L. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

M. Plaster/Stucco Substrates: Remove contaminants, release agents, curing compounds, efflorescence, chalk, mold, mildew, and similar deterrents. Spot patch existing plaster to eliminate blisters, buckles, excessive crazing, and to check cracking, dryouts, efflorescence, sweat outs, and similar deflects the prevent plaster from bonding with paint or coatings. Sand or texture repair or patch to match adjacent finish and to remove trowel marks and arrises.
   1. Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
   2. Deep Cracks: Clean out and fill deep cracks with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
   3. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions. Test for alkali using litmus paper.
   4. Allow patching and repair compounds to set and cure before painting.

N. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

O. Wood Substrates:
   1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime, stain, or seal wood to be painted. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
   4. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
   5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

P. Pipe Covering and Insulation: Clean to remove loose, foreign, and objectionable material before applying sealing coat.

Q. Preparation of Substrates for Wallcovering: Prime and seal substrate with release coat in accordance with wallcovering manufacturer's recommendations for substrate.
   1. Assure compatibility with product of wall covering manufacturer.
   2. Fill indentations in substrate and prime with opaque white primer before applying release coat.
   3. Apply release coat in accordance with manufacturer's recommendations.

R. Barrier Coat: Provide barrier coats over incompatible primers or remove and reprime. Notify Owner in writing of anticipated problems using specified finish coat material over previously coated substrates.

S. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Do not use thinners for water based paints.
4. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.4 APPLICATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
   1. The term exposed surfaces includes areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
   2. Use applicators and techniques suited for paint and substrate indicated.
   3. Provide finish coats compatible with primers.
   4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   5. Paint exposed surfaces. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces.
      a. Field painting of exposed surfaces include bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory applied final finish.
      b. Areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place.
      c. Extend coatings in areas, as required, to maintain system integrity and provide desired protection.
   6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
   7. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   8. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   9. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   10. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or surface imperfections. Cut in sharp lines and color breaks.
   11. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
   12. Provide finish coats compatible with primers used.
   13. Sand lightly between each succeeding enamel or varnish coat.

B. Items not to Receive Paint: Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

C. Applicators: Apply paints and coatings by brush, roller, spray, or applicators recommended by manufacturer.
   1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.

2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
1. Measure film thickness on magnetic surfaces by use of Elcometer thickness gauge and on nonmagnetic surfaces by pit gauge or Tooke Gauge.

E. Application: Apply first coat to surfaces that have been cleaned, pretreated, or prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
2. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished after removing rust and scale and priming or touching up surface sand if acceptable to topcoat manufacturers.
3. If undercoats, stains, or conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried and cured to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
7. Concealed Members: Wherever steel and metal parts to receive paint are built into and concealed by construction, paint as specified for exposed parts so finish painting is complete before members are concealed.

G. Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Painting is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.

3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

H. Electrostatic Spray Painting: Apply coating electrostatically to finished surfaces, free from runs, sags, visible overlaps, holidays, craters, pinholes and other defects detrimental to protective and decorative qualities of coating.
1. Thickness of Coatings: 1.5 to 2.0 mils dry film thickness. Measure dry film thickness with magnetic gauge.
2. Use application techniques, equipment, materials, and preparation procedures recommended by manufacturer.

I. Block Fillers: Apply block fillers to concrete masonry block at rate to ensure complete coverage with pores filled.

J. Prime Coats: Before applying finish coats, apply prime coat, recommended by manufacturer, to material required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or defects due to insufficient sealing.

K. Finish Coats: Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance without bleed through.
1. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or surface imperfections is not acceptable.
2. Transparent (Clear) Finishes: Use multiple coats to produce glass smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

M. Touch Up: Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
1. Prepare and touch up scratches, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.
2. Touch up marred, scraped, and blemished areas of factory primed or previously coated surfaces.
3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
4. As soon after erection and installation as possible, touch up fasteners, welded surfaces and surroundings, field connections, and areas on which shop coat has been abraded or damaged with specified primer before corrosion and other damage occurs from exposure.

3.5 FIELD QUALITY CONTROL

A. Dry Film Thickness (DFT) Testing: Tests for dry film thickness may be determined by using a Tooke Scale and microgroover, an electronic scanner, or the Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.6 CLEANING AND PROTECTION

A. It is of the upmost important to the Owner that the sites remain in a safe, clean, and well maintained condition. At the end of each day, leave the site ready to use by staff and students. Protect staff and students and the learning environment throughout the work.

B. Cleanup: At the end of each day, remove empty cans, rags, rubbish, and discarded paint materials from site. After completion of painting work, clean glass and paint spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. Provide “Wet Paint” signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After related work is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

E. At completion of painting activities, touch up and restore damaged or defaced painted surfaces.

F. Waste Management: Legally dispose of unused paint and paint containers in accordance with manufacturer’s recommendations and environmental regulations.

PART 4 SCHEDULES

4.1 GENERAL

A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.

B. Overhead Painting (Ceilings, Exposed to Structure Above, etc.)
   1. Use a dryfall system comparable to system defined below for substrate.

4.2 SHERWIN-WILLIAMS APPLICATION SCHEDULES

A. Exterior Surfaces: Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 will be used when standard earthtone colors or neutral colors are specified, and System 2 will be used when bright colors (primary reds, yellows, and oranges) are specified and/or when a graffiti resistant coating is required.
   1. Galvanized Metal:
      a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
      b. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
      c. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300).
   2. Galvanized Metal: Chloramine environment.
      a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
      b. Primer: One (1) coats Macropoxy 646 (B58-600).
      c. Finish: Two (2) coats Acrolon 218 HS Acrylic Polyurethane (B65-600).
   3. Galvanized Metal: Exterior Coastal environment.
      a. Surface Preparation: Clean per SSPC-SP 1 using detergent and water or a degreasing cleaner to remove greases and oils. Apply to a test area, priming as

required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP 16 is necessary to remove these treatments.
b. Primer: S-W Macropoxy 646-100 Fast Cure Epoxy, B58 Series (7.0-13.5 mils. wet, 5.0-10.0 mils. dry per coat).
c. Finish: Two coats S-W Hi-Solids Polyurethane Semi-Gloss, B65-350/B60V30 Series (4.5-8.0 mils. wet, 3.0-5.0 mils. dry per coat).

4. Un-galvanized Metal:
   a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310).
   b. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300).
5. Pre-Finished Metal Surfaces:
   a. Surface Preparation: As recomme3nded by primer manufacturer.
   b. Primer: One (1) coat Bond-Plex Waterbased Acrylic.
      1) OR
      2) Primer: One (1) coat DTM Bonding Primer.
   c. Finish: Two (2) coats Bond-Plex Waterbased Acrylic.
6. Concrete and CMU:
   a. Primer/Finish: (2) coats Loxon XP Exterior Waterproofing System, 14-18 mils wet, 6.4 – 8.3 mils dry per coat.
7. Tilt-Up Concrete:
   a. Primer: One (1) coat Loxon Concrete and Masonry Primer Sealer (LX02W50), 5.3-8.0 mils wet, 2.1-3.2 mils dry.
   b. Finish: One (1) coat Conflex UltraCrete Acrylic Textured Finish, Texture: Fine, Base Color: CF17W0811 Medium Extra White.
8. Wood (Includes plywood siding and wooden trim):
   a. Primer: One (1) coat A-100 Latex Wood Primer (B42W41).
   b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 ser.).
9. Fiber-Cement Materials:
   a. Primer: One (1) coat Loxon Masonry Primer (A24W300).
   b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 Series).
10. Parking Line and Driveway Paint: Setfast Waterborne Yellow (TM225) (meets Federal Specification (FS) TTP-1952-B)

B. Interior Surfaces:
   1. Concrete Substrates, Non-Traffic Surfaces and Clay Masonry:
      a. Latex System:
         1) Prime Coat: Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
         2) Intermediate Coat: Latex, interior, matching topcoat.
         3) Topcoat:
            (a) Flat: ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
            (b) Low Sheen: ProMar 200 Zero VOC Latex Low Sheen Eg-Shel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
            (c) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
            (d) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
            (e) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
      b. Water-Based Light Industrial Coating System:
         1) Prime Coat: Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
         2) Intermediate Coat: Latex, interior, matching topcoat.

3) Topcoat:
(a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
(b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

2. Concrete Substrates, Pedestrian Traffic Surfaces:
a. Latex Floor Enamel System:
1) First Coat: Floor paint, latex, slip-resistant, matching topcoat.
2) Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils (0.038 to 0.051 mm) dry per coat.

3. Flat: Galvanized Metal:
a. Latex System:
1) Prime Coat: One (1) coat Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
2) Intermediate Coat: Water-based acrylic, interior, matching topcoat.
3) Topcoat:
(a) Semi-Gloss: Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
(b) Gloss: Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
b. Water-Based Dry-Fall System:
1) Top Coat:
(a) Flat: S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-181 Series, at 6.0 mils (0.152 mm) wet, 1.5 mils (0.038 mm) dry.
(b) Eggshell: Pro Industrial Waterborne Acrylic DryFall Eg-Shel, B42-82, at 6.0 mils (0.152 mm) wet, 1.9 mils (0.048 mm) dry.
(c) Semi-Gloss: Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-83, at 5.8 mils (0.147 mm) wet, 2.3 mils (0.058 mm) dry.
c. Water-Based Light Industrial Coating System:
1) Prime Coat: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
3) Top Coat:
(a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
(b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

4. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
a. Shop coat by others.
b. One (1) coat over Steel Kem Kromik Primer B50series.
c. One (1) coat over Aluminum Metal Procryl Primer B60series.
d. Two (2) coats PM200 Alkyd Semi-Gloss B34series.

5. Wood: (Painted)
a. Latex System:
1) Prime Coat: PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
2) Intermediate Coat: Latex, interior, matching topcoat.
3) Topcoat:
(a) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.

(b) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
(c) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

b. Water/Alkyd Urethane System:
1) Prime Coat: Premium Wall & Wood Primer, B28W8111, at 4.0 mils (0.102 mm) wet, 1.8 mils (0.046 mm) dry.
2) Intermediate Coat: Water-based alkyd-urethane, interior, matching topcoat.
3) Topcoat:
(a) Semi-Gloss: Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
(b) Gloss: Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.

c. Water-Based Light Industrial Coating:
1) Prime Coat: PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
3) Topcoat:
(a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
(b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

6. Wood: (Stained)
a. Stain: SherWood BAC Wiping Stain (S64 Series).
b. Finish (First Coat): Wood Classics Polyurethane Varnish (A67 Series).
c. Finish (Second Coat): Wood Classics Polyurethane Varnish (A67 Series).

7. Gypsum Board and Plaster:
a. Latex System:
1) Prime Coat: ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
2) Intermediate Coat: Latex, interior, matching topcoat.
3) Topcoat:
(a) Flat: ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
(b) Low Sheen: ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
(c) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
(d) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
(e) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

b. Water-Based Light Industrial Coating System:
1) Prime Coat: ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
3) Topcoat:
(a) Eggshell: Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
(b) Semi-Gloss: Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

8. CMU: (Epoxy) - Kitchens, bathrooms, laboratories, etc.
   a. Primer: Two (2) coats Heavy Duty Block Filler (B42W46).
   b. Finish: Two (2) coats Water-Based Catalyzed Epoxy (B70/B60).
9. Pipe and fittings, including but not limited to copper and brass, at kitchen areas (but excluding aluminum, stainless steel, nickel and chrome plated pipe and fittings):
   a. Primer: One (1) coat; product recommended for the substrate by the finish coat manufacturer.
   b. Finish: Two (2) coats bright aluminum paint.

END OF SECTION 09 90 00

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SECTION 10 11 00 - VISUAL DISPLAY UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 01 General Requirements and References, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. Section Includes:
   1. Porcelain enamel steel markerboards.
   2. Tackboards.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry: Blocking and supports.
   2. Section 06 20 00 - Finish Carpentry: Wood frame and marker rails.
   3. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.
   4. Section 09 90 00 - Painting and Coating: Finishing of wood frame and marker rail.
   5. Section 10 22 39 - Folding Panel Partitions: Installation of visual display boards on operable partitions.

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).

C. ANSI A208.1 - American National Standard for Particleboard; 2022.

D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

E. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.

F. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012, with Editorial Revision (2019).

G. ASTM C1036 - Standard Specification for Flat Glass; 2021.

H. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

I. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.

J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

L. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.

M. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. PS 1 - Structural Plywood; 2023.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.

C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.

D. Samples: Color charts for selection of color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, and trim.

E. Samples: Two, 2 by 2 inches (50 by 50 mm) in size illustrating materials and finish, color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surfacing, and trim.

F. Test Reports: Show compliance to specified surface burning characteristics requirements.

G. Manufacturer's printed installation instructions.

H. Manufacturer's Qualification Statement.

I. Maintenance Data: Include data on regular cleaning, stain removal.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.

B. Provide five year warranty for chalkboard and markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
   1. Accessibility:
      a. Americans with Disabilities Act of 1990, as amended:
         1) ADA Title II Regulations & the 2016 ADA Standards for Accessible Design.
   2. Building Code:
      a. Comply with applicable requirements of International Building Code ICC (IBC).
   3. Fire Code:
      a. Comply with applicable requirements of International Fire Code ICC (IFC).

2.3 VISUAL DISPLAY UNITS

A. Porcelain Enamel Steel Markerboards:
   1. Color: White.
   2. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch (0.61 mm).
   3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
   4. Backing: Aluminum foil, laminated to core.
   5. Size: As indicated on drawings.
   6. Height: 4 feet.
   7. Frame: Same as for chalkboards.
   8. Frame: Extruded aluminum , with concealed fasteners.
   9. Frame Profile: As indicated on drawings.
   10. Frame Finish: Anodized, natural.
   11. Accessories: Provide marker tray and map rail.
   12. Basis of Design Products:

a. LCS3 as manufactured by Claridge Products and Equipment, Inc.

B. Tackboards: Fine-grained, homogeneous natural cork.
1. Basis of Design Product:
a. Fabricork Series #1550EW manufactured by Claridge Products and Equipment, Inc.
2. Cork Thickness: 1/8 inch (3 mm).
3. Fabric: Vinyl coated fabric.
4. Color: As selected by Architect from manufacturer's full range.
5. Backing: Hardboard, 1/4 inch (6 mm) thick, laminated to tack surface.
6. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
7. Size: As indicated on drawings.
8. Height: 4 feet.
9. Length: As indicated on drawings.
10. Frame: Extruded aluminum , with concealed fasteners.
11. Frame Profile: As indicated on drawings.
12. Frame Finish: Anodized, natural.
13. Accessories: Provide map rail.

2.4 MATERIALS

A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.

B. Hardboard for Chalk Surface: ANSI A135.4 Tempered type.

C. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
1. Laminated Safety Glass: Comply with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch (0.762 mm) thick, minimum.
3. Ionoplast Interlayer: 0.035 inch (0.889 mm) thick, minimum.

D. Vinyl Coated Fabric: ASTM F793 Category VI.

E. Burlap: Tightly woven, flame retardant treated.

F. Plywood: PS 1 Grade C-D , softwood.

G. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).

H. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.

I. Gypsum Board: ASTM C1396/C1396M, paper/foil faced, plain type.

J. Fiber Board: ASTM C208, cellulosic fiber board.

K. Foil Backing: Aluminum foil sheet, 0.005 inch thick (0.13 mm thick).

L. Aluminum Sheet Backing: 27 gauge, 0.014 inch (0.36 mm) thick.

M. Steel Sheet Backing: 28 gauge, 0.0149 inch (0.38 mm), galvanized.

N. Adhesives: Type used by manufacturer.

2.5 ACCESSORIES

A. Wood Frames: Factory assembled red oak, with factory applied clear varnish finish.

B. Wood Frames: Refer to Section 06 20 00 - Finish Carpentry.

C. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall (; 25 mm wide overall) , full width of frame.

D. Map Supports: Formed aluminum sliding hooks and roller brackets to fit map rail.

E. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.

F. Flag Holders: Cast aluminum bored to receive 1 inch (25 mm) diameter flag staff, bracketed to fit top rail of board.

G. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.

H. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.

I. Marker Tray: Wood; species and finish to match frame, style as indicated on drawings.

J. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

C. Verify flat wall surface for frameless adhesive-applied boards.

3.2 PREPARATION

A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.

B. Remove switchplates, wall plates, and surface-mounted fixtures where tackable wall paneling is applied. Reinstall items on completion of installation.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.

B. Install with top of marker tray at 30 inches (760 mm) above finished floor.

C. Secure units level and plumb.

D. Carefully cut holes in boards for thermostats.

E. Install tackable wall panels in accordance with manufacturer's recommendations on specified substrates with concealed attachments.
   1. Fabricate re-wrapped edges where partial panels about each other, or adjacent surfaces or trim.
   2. Re-wrap top, bottom or side edges for cutting panels around door or window openings, abutting trim, protruding objects, and at other openings, including x-cut at receptacles, light switches, and other openings.
      a. Wrap minimum 2 inches (51 mm) around back of panel.
      b. Carefully cut fiber board, leaving vinyl wallcovering intact. Wrap wallcovering tightly around edge of board and adhere continuously around back of panel with manufacturer's recommended vinyl wallcovering adhesive.

3.4 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.

B. Cover with protective cover, taped to frame.

C. Remove temporary protective cover at Date of Substantial Completion.

D. Break-in slate chalkboards with a chalk and clean treatment.

END OF SECTION 10 11 00

SECTION 10 12 00 - DISPLAY CASES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Recessed display cases.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry : Blocking and supports.

B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.3 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.

B. Product Data: Submit complete printed data and installation details indicating products to be provided as specified.
   1. Submit color charts for selection by Architect.

C. Shop Drawings: Submit complete installation details. Include dimensioned elevations.

D. Samples: Submit samples of material and trim to illustrate finish, color, and texture.

E. Manufacturer's Qualification Statement.

F. Maintenance Data: _____.

G. Specimen Warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver display cases and materials to the Project site with manufacturer’s protective crate covering and do not open until ready for use.

B. Protect display cases before, during, and after installation. In case of damage, immediately provide necessary repairs and replacements.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify field measurements for recessed application for display cases before preparation of shop drawings and before fabrication to ensure proper installation.

1.8 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against defects and in materials, finish product and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
   1. Claridge Products and Equipment, Inc: www.claridgeproducts.com/#sle.
   2. MooreCo, Inc: www.moorecoinc.com/#sle.
   3. Nelson Adams NACO: www.nelsonadamsnaco.com/#sle.

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 DISPLAY CASES

A. Recessed Display Case: Factory-fabricated wood-framed display case with adjustable glass shelves, finished interior, and aluminum trim on face to cover edge of recessed opening.
   1. Size: As indicated in Drawings.
   2. Components:
      a. Glazed Doors: Sliding.
         1) Number of Doors: Two pair.
      b. Side Panels: Stained veneer plywood.
      c. Back Panel: Tackable.
      d. Top Panel: Stained veneer plywood.
      e. Bottom Panel: Stained veneer plywood.
      f. Lighting: Fluorescent.

2.3 COMPONENTS

A. Wood Case Construction: 3/4 inch (19 mm) 7-ply maple veneer plywood with manufacturer's standard stain.

B. Aluminum Framed Case Construction: 1-1/2 inch by 2 inch (38 mm by 51 mm) extruded aluminum tube frame with tempered glass, laminate-faced, and stained veneer plywood infill panels.

C. Aluminum Case Construction: Aluminum side, bottom, and top panels fabricated from extruded aluminum shapes.

D. Face Frame Trim for Recessed Installation: 2 inch (51 mm) flat face dimension extruded aluminum trim mitered with corner clips and mechanical fasteners.

E. Glazed Sliding Doors:
   1. 1/4 inch (6 mm) clear tempered glass with plastic finger pulls.
   2. Door track: Extruded aluminum glass shoe with bottom rollers and top plastic guide.
   3. Lock: Glass door cylinder lock.

F. Glazed Hinged Doors:
   1. 1/4 inch (6 mm) clear tempered glass framed with 1/2 inch by 1 inch (13 mm by 25 mm) extruded aluminum trim.
   2. Hinges: 1 inch by .040 inch (25 mm by 1 mm) nickel-plated steel-continuous piano hinges.
   3. Lock: Glass door cylinder lock.

G. Glass Shelves:
   1. 1/4 inch (6 mm) clear tempered glass with flat-polished edges.
   2. Shelf Depth: 6 inches (152 mm).

3. Shelves per Unit: Two.

H. Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
1. Standards Mounting: Recess-mounted into back panel.
2. Face Width: 5/8 inch (16 mm).
3. Material: 16 gauge, 0.0598 inch (1.52 mm) sheet steel.
4. Lengths: As indicated on drawings.
5. Finish: Anochrome.
6. Brackets: Boltless with lip front; 16 gauge, 0.0598 inch (1.52 mm) sheet steel, reinforced, locking into slots; size to suit shelves; same finish as standards.

I. Tackable Back Panel: Fine-grained, homogeneous natural cork on hardboard.
1. Cork Thickness: 1/8 inch (3 mm).
2. Fabric: Vinyl fabric; minimum fabric weight: 13 oz/sq yd (440 g/sq m).
3. Color, Texture, Weave, and Pattern: As selected from manufacturer's full range.
4. Backing: Hardboard, 1/4 inch (6 mm) thick, factory laminated to tack surface.
5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.

J. Laminate Back Panel: Low-pressure laminate on one face of plywood substrate.
1. Laminate Color and Texture: As selected from manufacturer's full range.

K. Lighting: Manufacturer's standard fluorescent light fixture housed at top of case with louvered aluminum access door with keyed lock.
1. Surface Mounted: Under cabinet type fixture.
2. Recessed: Fixture with egg crate diffuser.
3. Controls: On/Off using dedicated wall switch.

2.4 MATERIALS

A. Aluminum Extrusions for Framing and Trim: Alloy as recommended by manufacturer for construction and specified finish; nominal 1/8 inch (3.2 mm) wall thickness.

B. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper.
1. Finish: Factory anodized; AAMA 611: Clear anodized.
2. Finish: Factory finished; AAMA 2603: Powder coat; _____ color.

C. Plywood: Softwood plywood with veneer core, waterproof glue, 3/4 inch (19 mm) thick.

D. Heat-Strengthened and Fully Tempered Glass: ASTM C1048, Kind FT.

PART 3 EXECUTION

3.1 PREPARATION

A. Rough openings, electrical pre-wiring, and final finishing are by other trades.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide factory trained installers.

C. Locate fastening devices to secure cases securely to back and sides of rough opening.

D. Install recessed display cases plumb and level in wall openings, ____ inches (____ mm) from finished floor to inside bottom of display case.

E. Refer to drawings for display case mounting heights.

F. Provide vinyl wrapped H-moldings to match vinyl covered boards.

G. Clean case and glass using manufacturers recommended procedures.

H. Provide mitered and wrapped hairline joints for all trims.

3.3 ADJUSTING AND CLEANING

A. Verify that all accessories are installed as detailed for each unit.

B. At completion of work, clean glass surfaces, back panels and trim in accordance with manufacturer's recommendations leaving units ready for use.

3.4 CLOSEOUT ACTIVITIES

A. Refer to Section 01 77 00 - Closeout Procedures, for closeout submittals.

END OF SECTION 10 12 00

SECTION 10 14 00 - SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Room and door signs.

B. Related Sections:
   1. Section 05 51 00 - Metal Stairs: Photoluminescent stair nosings.
   2. Section 05 52 00 - Metal Railings: Photoluminescent handrail strips.
   3. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
   4. Section 26 05 53 - Identification for Electrical Systems.
   5. Section 26 51 00 - Interior Lighting: Exit signs required by code.

1.2 REFERENCE STANDARDS

A. 19 TAC 61.1031 - School Safety Requirements; Current Edition.

B. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

C. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

D. ASTM B124/B124M - Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes; 2020.

E. ASTM E2072 - Standard Specification for Photoluminescent (Phosphorescent) Safety Markings; 2014.

F. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

H. NFPA 170 - Standard for Fire Safety and Emergency Symbols; 2021.

I. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

J. UL 1994 - Luminous Egress Path Marking Systems; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.

B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
   1. When room numbers to appear on signs differ from those on Drawings, include the drawing room number on schedule.
   2. When content of signs is indicated to be determined later, request such information from the Owner through the Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
   3. Submit for approval by the Owner through the Architect prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.

F. Verification Samples: Submit samples showing colors specified.

G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

H. Manufacturer's Qualification Statement.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.6 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Flat Signs:
      a. Best Sign Systems, Inc: www.bestsigns.com.
      b. Cosco Industries: www.coscoarchitecturalsigns.com.
      c. FASTSIGNS: www.fastsigns.com.
      d. Inpro: www.inprocorp.com.
      e. Mohawk Sign Systems, Inc: www.mohawksign.com.
      f. Seton Identification Products: www.seton.com/aec.
   2. Cable-Supported Signage:
      a. 3-form: www.3form.com.
      b. Nova Display Systems, Inc.: www.novadisplay.com.
      c. Takeform: www.takeform.net.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and Texas Accessibility Standards (TAS) and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with engraved panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
   3. Character Height: 1 inch (25 mm).
   4. Sign Height: 2 inches (50 mm), unless otherwise indicated.
   5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide two additional areas or slots that allow for modifications and additions to the room signage to accommodate the flexibility of spaces.
   6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide two additional areas or slots that

allow for modifications and additions to the room signage to accommodate the flexibility of spaces.

7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

C. Exterior Door Numbering: Provide numbering of exterior doors in compliance with 19 TAC 61.1031 and ICC (IFC) Section 505.
   1. Fabrication:
      a. Material: Retro-reflective vinyl characters applied to door system.
         1) Vinyl Basis of Design Product:
            (a) Scotchlite Removable Deflective Graphic Film manufactured by 3M.
      b. Characters: Arabic numerals or standard English alphabetical letters.
      c. Font: Arial or similar sans serif.
      d. Height: As indicated on Drawings, 4 inches (102 mm) minimum.
      e. Stroke Width: 1/2 inch (12.7 mm), minimum.
      f. Color: Black or White to contrast with background color.
   2. Locations: As indicated on Drawings.

2.3 SIGN TYPES

A. Flat Signs: Signage media without frame.
   1. Edges: Square.
   2. Corners: Square.
   3. Frame Finish: Natural (clear) anodized.
   4. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
   5. Wall Mounting of One-Sided Signs: Tape adhesive.

B. Cable-Supported Signage:
   1. Basis of Design:
      a. Products manufactured by Nova Display Systems, Inc.
   2. Cable:
      a. Material: Galvanized Steel.
      b. Thickness: 1.5 mm.
   3. Suspension: As indicated on Drawings.
   4. Cable Display Fittings:
      a. Cable Display Fittings:
         1) Material: Brass alloy complying with ASTM B124/B124M.
      b. Edge Grips, Sign Supports, and Standoffs:
      c. Finish: Satin Chrome.
   5. Signage:
      a. Material: Acrylic.
      b. Graphics: As indciated on Drawings.

C. Rod-Supported Signage:
   1. Basis of Design:
      a. Products manufactured by Nova Display Systems, Inc.
   2. Rod:
      a. Material: Galvanized Steel.
      b. Thickness: 1.5 mm.
   3. Suspension: As indicated on Drawings.
   4. Signage:
      a. Material: Acrylic.
      b. Graphics: As indciated on Drawings.

D. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.
   3. Background Color: Clear.
   4. Character Color: Contrasting color.

2.4 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

B. Exposed Screws: Chrome plated.

C. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Where signage is adhered to glazing and will be visible from the opposite side, provide a cover plate to obscure back of signage. Furnish and install cover in material, shape, and size to match signage.

C. Install neatly, with horizontal edges level.

D. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

E. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 10 14 00

SECTION 10 21 13.19 - PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Solid plastic toilet compartments.

B. Urinal and vestibule screens.

1.2 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Concealed steel support members.

B. Section 05 50 00 - Metal Fabrications: Concealed steel support members.

C. Section 06 10 00 - Rough Carpentry: Blocking and supports.

D. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

E. Section 10 28 19 - Tub and Shower Enclosures: Shower compartment construction.

1.3 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

D. Samples: Submit two samples of partition panels, 6 by 6 inches (150 by 150 mm) in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

1. Solid Plastic Toilet Compartments:
    a. All American Metal Corp - AAMCO: www.allamericanmetal.com/#sle.
    b. AJW Architectural Products: www.ajw.com/#sle.
    c. ASI Accurate Partitions: www.asi-accuratepartitions.com/#sle.
    d. ASI Global Partitions: www.asi-globalpartitions.com/#sle.
    e. Inpro: www.inprocorp.com/#sle.
    f. Metpar Corp: www.metpar.com/#sle.
    g. Partition Systems International of South Carolina: www.psisc.com/#sle.
    h. Scranton Products: www.scrantonproducts.com/#sle.
    i. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 PLASTIC TOILET COMPARTMENTS

A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted, headrail-braced.
   1. Basis of Design: Hiny Hiders as manufactured by Scranton.
   2. Color: Stainless Grip EX.
   3. Doors:
      a. Thickness: 1 inch (25 mm).
      b. Width: 24 inch (610 mm).
      c. Width for Wheelchair Accessible Compartments: 36 inch (915 mm), out-swinging.
      d. Height: 55 inch (1397 mm).
   4. Panels:
      a. Thickness: 1 inch (25 mm).
      b. Height: 55 inch (1397 mm).
      c. Width: As indicated on Drawings.
   5. Pilasters:
      a. Thickness: 1 inch (25 mm).
      b. Width: As indicated on Drawings.
   6. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.3 ACCESSORIES

A. Pilaster Shoes: Stainless steel, satin finish, 3 inches (76 mm) high; concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
   2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.

B. Head Rails: Extruded aluminum, anti-grip profile.
   1. Size: Manufacturer's standard size.

C. Wall and Pilaster Brackets: Stainless steel; manufacturer's standard type for conditions indicated on drawings.

D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.

E. Hinges: Stainless steel, manufacturer's standard finish.
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Continuous-type hinge, self closing.

F. Door Hardware: Stainless steel, manufacturer's standard finish.
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Nylon bearings.
   3. Door Latch: Slide type with exterior emergency access feature.
   4. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
   5. Provide door pull for outswinging doors.
   6. Coat Hook: Refer to Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

G. Toilet Partition Suspension Members: Refer to Section 05 50 00 - Metal Fabrications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets.

E. Locate head rail joints at pilaster center lines.

F. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch (6 mm).

B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.4 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).

B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 10 21 13.19

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SECTION 10 21 23 - CUBICLE CURTAINS AND TRACK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended, overhead curtain track and guides.

B. Surface-mounted, overhead curtain track and guides.

C. Cubicle curtains.

D. Blackout curtains.

1.2 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Above ceiling track supports.

B. Section 06 10 00 - Rough Carpentry: Above ceiling blocking and track supports for track.

C. Section 09 51 00 - Acoustical Ceilings: Suspended ceiling system to support track.

1.3 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide data for curtain fabric characteristics.

C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.

D. Samples: Submit 12 by 12 inch (300 by 300 mm) sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement and carrier attachment to curtain header.

E. Samples: Submit 12 inch (300 mm) sample length of curtain track including typical splice, wall and ceiling hanger, and escutcheon.

F. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

G. Maintenance Data: Include recommended cleaning methods and materials and stain removal methods.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Curtains: Two of each type and size.
   3. Extra Carriers: Ten.

1.5 MOCK-UP

A. Provide mock-up, 6 inches by 6 inches wide, with curtain track, curtain, cords and accessories.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept curtain materials on site and inspect for damage.

B. Store curtain materials on site and deliver to Owner for installation when requested.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
   1. A. R. Nelson Co: www.arnelson.com/#sle.
   2. Construction Specialties, Inc; Track Systems: www.c-sgroup.com/#sle.
   3. Imperial Fastener Co., Inc: www.imperialfastener.com/#sle.
   4. Inpro: www.inprocorp.com/#sle.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 TRACKS AND TRACK COMPONENTS

A. Tracks: Extruded aluminum sections; one piece per track run.
   1. Profile: Channel.
   2. Mounting: Surface.
   3. Structural Performance: Capable of supporting vertical test load of 50 lbs (23 kg) without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
   4. Track End Stop: To fit track section.
   5. Track Bends: Minimum 12 inch (300 mm) radius; fabricated without deformation of track section or impeding movement of carriers.
   6. Suspension Rods: Tubular aluminum sections, sized to support design loads and designed to receive attachment from track and ceiling support.
   7. Escutcheons: Where suspension rod meets finished ceiling or structure, provide escutcheons to match rod finish.
   8. Finish on Exposed Surfaces: Clear anodized.
   9. Products:
      a. American Track Supply; Aluminum Track: www.americantracksupply.com/#sle.
      b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

B. Curtain Carriers: Nylon rollers, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.
   1. Provide __ carriers per foot of track length (__ carriers per meter of track length)

C. Wand: Plastic, attached to lead carrier, for pull-to-close action.

D. Installation Accessories: Types required for specified mounting method and substrate conditions.

2.3 CURTAINS

A. Cubicle Curtains:
   1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   2. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
   3. Material: Close weave polyester; anti-bacterial, self deodorizing, sanitized, and preshrunk.
   4. Color/Pattern: As selected by Owner from Manufacturer's full range.
   5. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, manufacturer's standard color.
   6. Attachment of Curtain Fabric to Open Mesh Cloth: Manufacturer's standard sewn seam.
   7. Products:
      a. Imperial Privacy Systems.
      b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

B. Curtain Fabrication:

1. Width of curtain to be 10 percent wider than track length.
2. Length of curtain to end 15 inches (380 mm) above finished floor.
3. Railroad fabric without vertical seams.
4. Pattern match fabric with vertical seams.
5. Include open mesh cloth at top 20 inches (508 mm) of curtain for room air circulation, attached to curtain as specified above.
6. Curtain Heading: Fabric band matching curtain panel with metal grommet holes for carriers spaced 6 inches (150 mm) on center.
7. Seams and Hems: Manufacturer's standard fabrication method for securely sewn and finished seams and hems.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.

B. Verify that field measurements are as indicated.

3.2 INSTALLATION

A. Install curtain track to be secure, rigid, and true.

B. Refer to Section 05 50 00 - Metal Fabrications for track supports above ceiling.

C. Refer to Section 06 10 00 - Rough Carpentry for blocking and track supports above ceiling.

D. Secure track to ceiling system.

E. Install end cap and stop device.

F. Install curtains on carriers ensuring smooth operation.

END OF SECTION 10 21 23

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SECTION 10 22 39 - FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Top-supported folding panel partitions, horizontal opening.
   2. Top-supported operable panel partitions, vertical opening, electrical operation.

B. Related Requirements:
   1. Section 06 10 00 - Rough Carpentry: Wood blocking and track support shimming.
   2. Section 08 71 00 - Door Hardware: Lock cylinders for panels
   3. Section 09 90 00 - Painting and Coating: Field applied paint finish to panels.
   4. Section 10 11 00 - Visual Display Units: Product requirements for markerboard finish for installation by this section.

1.2 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

E. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

I. ASTM E413 - Classification for Rating Sound Insulation; 2022.

J. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation Between Spaces Separated by Operable Partitions; 2012 (Reapproved 2020).

K. ASTM E596 - Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures; 2022.

L. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
   1. Require attendance by representatives of installer.
   2. Notify Architect four calendar days in advance of scheduled meeting date.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, track switching components, and colors and finishes available.

C. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.

D. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, and stacking depth.

E. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.

F. Samples for Review: Submit two samples of surface finish, 12 by 12 inches (300 by 300 mm) size, illustrating quality, colors selected, texture, and weight.

G. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.

H. Manufacturer's Instructions: Indicate special procedures.

I. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

1.7 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.

B. Correct defective Work within five year period after Date of Substantial Completion.

C. Provide two year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Folding Panel Partitions - Horizontal Opening:
      a. Kwik-Wall Company: www.kwik-wall.com.
      b. Moderco, Inc: www.moderco.com.
      c. Modernfold, a DORMA Group Company: www.modernfold.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

A. Basis of Design Product:
   1. Acoustiseal Legacy manufactued by Modernfold.

B. Folding Panel Partitions: Side opening; paired panels; side stacking; manually operated.

C. Panel Construction:
   1. Frame: 16 gauge, 0.0598 inch (1.52 mm) thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.
   2. Substrate: Gypsum board.
   3. Panel Substrate Facing: Steel sheet, manufacturer's standard thickness.
   4. Hinges: Continuous piano type.

5. Panel Properties:
   a. Thickness With Finish: 3 inches (75 mm).
   b. Width: Standard width.
   c. Weight: 8 lb/sq ft (40 kg/sq m).

D. Panel Finishes:
   1. Facing: As indicated on Drawings.
   2. Trim: Concealed.

E. Panel Seals:
   1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
   2. Acoustic Seals: Flexible acoustic seals at jambs, meeting mullions, ceilings, retractable floor and ceiling seals, and above track to structure acoustic seal.

F. Suspension System:
   1. Track: Formed steel; 0.12 inch (3 mm) in size; thickness and profile designed to support loads, steel sub-channel and track connectors, and track switches.
   2. Carriers: Steel, ball bearing wheels on trolley carrier at top of every second panel, sized to carry imposed loads, with threaded pendant bolt for vertical adjustment.

G. Performance:
   1. Acoustic Performance:
      a. Noise Reduction Coefficient (NRC): ASTM E596, NRC of 0.65 minimum.
      b. Sound Transmission Class (STC): 50 STC calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft (9.3 sq m).
   2. Surface Burning Characteristics of Panel Finish: Flame spread/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
   3. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.

H. Operation:
   1. Manual.
   2. Safety Features:
      a. Pocket Door Interlock: Mechanism to prevent operation of panels unless storage pocket doors are fully open.

I. Accessories:
   1. Ceiling Closure: White enameled ceiling closure; aluminum jamb and head molding, fittings and attachments, and intermediate meeting posts.
   2. Pocket Enclosures: Door, frame, and trim to match adjacent walls.
   3. Acoustic Sealant: As recommended by partition manufacturer.

2.3 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Standard Gypsum Board: ASTM C1396/C1396M, 3/8 inch (9.5 mm) thick, maximum permissible length; ends square cut, square edges.

C. Fire Rated Gypsum Board: ASTM C1396/C1396M, Type X, UL rated; 1/2 inch (12.7 mm) thick, maximum practical length; ends square cut, square edges.

D. Acoustic Insulation:
   1. Type: As required for acoustic performance indicated.
   2. Thickness: As required for acoustic performance indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.

C. Verify track supports are laterally braced and will permit track to be level within 1/4 inch (6.4 mm) of required position and parallel to the floor surface.

D. Verify floor flatness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.

E. Verify wall plumbness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.

3.2 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.

B. Install electric operator, wiring, and controls. Locate control station(s) as indicated.

C. Fit and align partition assembly and pocket doors level and plumb.

D. Lubricate moving components.

E. Install acoustic sealant to achieve required acoustic performance.

F. Coordinate electrical connections.

3.3 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

C. Adjust partition assembly to achieve lightproof seal.

3.4 CLEANING

A. Clean finish surfaces and partition accessories.

3.5 CLOSEOUT ACTIVITIES

A. Demonstrate operation of partition and identify potential operational problems.

END OF SECTION 10 22 39

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Corner guards.

B. Related Requirements:
   1. Section 05 50 00 - Metal Fabrications: Anchors for attachment of work of this section, concealed in wall.
   2. Section 05 52 00 - Metal Railings: Metal railings not intended to protect walls..
   3. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.
   4. Section 09 21 16 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

1.3 REFERENCE STANDARDS

A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.

B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

D. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.

E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

F. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

G. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

H. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

I. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.

C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.

D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
   1. Submit two sections of corner guards, 24 inches (610 mm) long.

E. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
   1. Refer to Section 01 60 00 - Product Requirements for additional provisions.

2. Extra Stock Materials: One package(s) of minimum 96 inches (2438 mm) long unit of each kind of covers for corner guards.

H. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

B. Protect work from moisture damage.

C. Protect work from UV light damage.

D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.

E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.6 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in Owner's name and register with manufacturer.
1. Failures include, but are not limited to, the following:
a. Structural failures or internal connection failures.
b. Deterioration of materials beyond that expected of normal use, as intended by manufacturer.

C. Installer Warranty: Provide 5-year warranty for metal crash rails commencing on Date of Substantial Completion. Complete forms in Owner's name and register with installer.
1. Failures include, but are not limited to, the following:
a. Detachment of rail system from substrate.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Corner Guards:
a. Babcock-Davis: www.babcockdavis.com/#sle.
b. Construction Specialties, Inc: www.c-sgroup.com/#sle.
c. Inpro: www.inprocorp.com/#sle.
d. Koroseal Interior Products: www.koroseal.com/#sle.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

A. Regulatory Requirements:
1. Regulatory Requirements:
a. Code Standards:
1) Refer to specification Section 01 41 00 - Regulatory Requirements for code requirements and code standards applicable to all materials and work necessary to complete the scope of work.
2. Welding Qualifications: Qualify procedures and personnel according to the following:

a. Aluminum: AWS D1.2/D1.2M.
b. Sheet Steel: AWS D1.3/D1.3M.
c. Stainless Steel: AWS D1.6/D1.6M.
d. Steel: AWS D1.1/D1.1M.

2.3 PERFORMANCE CRITERIA

A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.

B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.

C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.4 PRODUCT TYPES

A. Corner Guards - Surface Mounted, High-Impact Vinyl:
1. Basis of Design: Korogard G400 Series manufactured by Koroseal Interior Products, Inc.
2. Material: High impact vinyl with full height extruded aluminum retainer.
3. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
5. Width of Wings: 2-11/16 inches.
6. Corner: 1-1/4 inch radius.
7. Color: As selected by Architect from manufacturer's standard finishes.
8. Length: One piece, 48 inches (1219 mm).
9. Preformed end caps.
10. Mounting: Continuous aluminum retainer with countersunk holes..

2.5 FABRICATION

A. Fabricate components with tight joints, corners and seams.

2.6 SOURCE QUALITY CONTROL

A. Refer to Section 01 40 00 - Quality Requirements, for additional requirements.

B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that field measurements are as indicated on drawings.

C. Verify that substrate surfaces for adhered items are clean and smooth.
1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

D. Start of installation constitutes acceptance of project conditions.

3.2 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

3.3 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch (6 mm).

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.4 CLEANING

A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 10 26 00

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Washroom accessories.
   2. Toilet accessories.
   3. Shower room accessories.
   4. Warm air dryers.
   5. Childcare accessories.
   6. Custodial accessories.
   7. Accessories necessary for a complete installation.

1.2 REFERENCE STANDARDS

A. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

B. ASTM F446 - Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area; 2019.

C. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.

D. ISO 17966 - Assistive products for personal hygiene that support users - Requirements and test methods; Current.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 60601 - UL Standard for Safety Medical Electrical Equipment, Part 1: General Requirements for Safety; Current.

1.3 PERFORMANCE REQUIREMENTS

A. Grab Bars:
   1. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:

1.4 SUBMITTALS

A. Product Data: Technical Data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   1. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   2. Include electrical characteristics.

B. Samples: Provide a sample to demonstrate each exposed product finish specified.

C. Product Schedule: Show types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated.

D. Maintenance Data: Submit for inclusion in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Accessibility Requirements: Comply with applicable requirements.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Source Limitations: Obtain products from single source from single manufacturer.

1.6 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.7 WARRANTY

A. Mirrors: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, visible silver spoilage defects.
   2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

B. Substitutions: Refer to 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

A. Mirrors: ASTM C1503, Mirror Glazing Quality, clear glass mirrors, nominal 6.0 mm thick

2.3 COMPONENTS

A. Underlavatory Guard: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
   1. Material and Finish: Antimicrobial, molded plastic, white

2.4 FABRICATION

A. Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items. Remove temporary labels and protective coatings. Clean and polish exposed surfaces according to manufacturer's written recommendations.

PART 4 SCHEDULE

4.1 TOILET ACCESSORY SCHEDULE

A. TA-1C - Soap Dispensers – Counter-Mounted:

1. Mounting: Undercounter.
2. Basis of Design: Bobrick B-8226.
3. Locations: Where indicated on Drawings.

B. TA-1W - Soap Dispensers – Wall-Mounted:
1. Mounting: Surface.
2. Basis of Design: Bobrick B-2111.
3. Locations: Where indicated on Drawings.

C. TA-2 - Lavatory Mirrors, Typical:
1. Mounting: Surface.
2. Basis of Design: Bobrick B-290.
3. Size: _____ inches by _____ inches.
4. Location: At each lavatory.

D. TA-2F - Full-Length Mirrors:
1. Mounting: Surface.
2. Basis of Design: Bobrick B-290.
3. Size: 24 inches by 72 inches.
4. Location: Where indicated on Drawings.

E. TA-3 - Toilet Paper Dispensers:
1. Mounting: Surface.
2. Basis of Design: Bobrick B-265.
3. Locations: At each water closet.

F. TA-4 - Paper Towel Dispensers:
1. Mounting: Surface.
2. Basis of Design: Bobrick B-262.
3. Locations: Where indicated on Drawings.

G. TA-5 - Grab Bars: (At Wheelchair-Accessible Water Closets):
1. Size/Finish: 1-1/2 inch diameter satin stainless steel.
2. Basis of Design: Bobrick B-6806.
3. Mounting: Attach with concealed mounting kit. Mount parallel to floor.
4. Location: At each wheelchair-accessible water closet.

H. TA-6 - Sanitary Napkin Dispensers:
1. Mounting: Surface.
2. Basis of Design: Bobrick B-2706.
3. Operation: Single coin / Double coin - (25/50 cents).
4. Capacity: 20 Napkins/ 30 Tampons.
5. Locations: At each women’s toilet room.

I. TA-7 - Sanitary Napkin Disposal:
1. Mounting: Surface.
2. Basis of Design: Bobrick B-270.
3. Locations: Where indicated on Drawings.

J. TA-8 - Shelf with Mop and Broom Holders and Hooks:
1. Mounting: Surface.
2. Model No.: B-239 x 34.
3. Capacity: Four hooks, three mop holders.
4. Locations: Mop sink at each custodial rooms.

K. TA-9 - Grab Bars: (At Accessible Shower):
1. Mounting: Surface.
2. Basis of Design: Bobrick B-6861 modified (24 x 16).
3. Locations: At each accessible shower stall.

L. TA-10A - Folding Benches: Adult Height:
   1. Mounting: Surface, reversible.
   2. Basis of Design: Bobrick B-5181.
   3. Locations: Where indicated on Drawings.

M. TA-10C - Folding Benches, Child Height (15 inches (375 mm) seat height):
   1. Mounting: Surface, reversible.
   2. Basis of Design: Bobrick B-5181.
   3. Locations: Where indicated on Drawings.

N. TA-11 - Clothing Hook:
   1. Mounting: Surface.
   2. Basis of Design: Bobrick B-6717.
   3. Locations: All shower locations.
   4. Toilet and Shower Partitions: If toilet and shower partitions are utilized, hooks are to be provided by the partition manufacturer(s) as part of their hardware package.

O. TA-12 - Shower Curtains, Rods and Hooks:
   1. Basis of Design:
      a. Rods: Bobrick B-6107 (36 inches or as indicated).
      b. Curtains: Bobrick B-204-2 (42 inches x 72 inches or as required).
      c. Hooks: Bobrick B-204-1.
   2. Mounting/Locations: Where indicated on Drawings.

P. TA-13 - Electric Hand Dryers:
   1. Mounting: Semi-Recessed, maximum 3-9/16 inch recess.
   2. Basis of Design: Bobrick B-750, white.
   3. Voltage: 120 volt, single phase.
   4. Location: Where indicated on Drawings.

Q. TA-14 - Paper Towel Dispenser/Trash Receptacle Combination:
   1. Mounting: Surface.
   2. Basis of Design: Bobrick B-3949.
   3. Locations: Where indicated on Drawings.

R. TA-15 - Grab Bars: (At Ambulatory-Accessible Toilet Compartments):
   1. Size/Finish: 1-1/2 inch diameter satin stainless steel, lengths as indicated in drawings.
   2. Basis of Design: Bobrick B-6806.
   3. Mounting: Attach with concealed mounting. Mount parallel to floor.
   4. Location: At each ambulatory-accessible toilet compartment.

S. TA-16 - Baby Changing Station:
   1. Type: Horizontal station to accommodate infants and toddlers.
   2. Basis of Design:
      a. Model KB200 manufactured by Koala Kare Products, a division of Bobrick.
   3. General Requirements:
      a. Comply with applicable accessibility and regulatory requirements..
      b. Comply with with ASTM F2285.
      c. Provide universal instruction graphics and safety messages in multiple languages.
      d. Provide replacable restraining straps.
   4. Construction and Features:
      a. Dimensions: 35 inches long by 22 inches high by 4 inches deep.
      b. FDA approved injection molded polypropylene with steel on steel hinge system. Fabricate to withstand static loads over 400 pounds.
      c. Child protection straps with snap lock fasteners.
      d. Built-in diaper bag hooks.
      e. Built-in sanitary liner dispensers; 3 ply, biodegradable.

f. Premium gas spring mechanism.
g. Molded usage and safety instructions in six languages and Braille.
h. Comply with applicable accessibility regulations.
i. Antifungal to comply with ASTM standards.

5. Color: As selected by Architect from manufacturer's full line.
6. Finish: Manufacturer's standard stainless steel.
7. Location: Where indicated on Drawings.

T. TA-16A - Adult Changing Station:
1. Type: Horizontal, adjustable-height station to accommodate adults.
2. Construction and Features:
a. Safety: Unit tested to meet ISO/IEC 60601-2-52, UL 60601, and ISO 17966 Unit shall have a battery backup system to safely operate changing bed in the event of a power interruption.
b. Unit designed to have redundancy by being equipped with two chains for height adjustability.
c. Emergency Stop: Unit is equipped with emergency stopISO 2858 to break power to actuator in an emergency.
d. Powered-Height Adjustability: Electronically adjustable from 12 inches (300 mm) to 41 inches (1041 mm). Unit shall have two sets of electronic controls: located on face of wall cover; and, on front of changing bed in open, down position. Provide optional control pendant available for height adjustment.
e. Front Safety Guard: One-hand operation. Guard shall lock in raised position along front side of changing bed. Guard shall have dip in top edge to facilitate caregiver reaching over guard to change patient. Guard shall rotate and lock under changing bed in stored position.
f. Weight Capacity: Tested to support 500 lbs (227 Kg). static load.
g. Durability: Cycle tested through range of motion 28,000 times at 500lbs. Stress tested to 100,000 cycles with 500lbs. bounce load test. Meets IK10 impact rating.
h. Cleaning: The unit shall be designed and tested to meet IPX4 rating and shall have no exposed wiring/cables for disinfecting and cleaning. Unit can be hosed without compromising the electronics.
i. Frame: Shall be constructed of 2 inchpowder coated steel tubing.
j. Changing Bed: Surface shall be 75-1/4 inches (1911 mm) long, 31-1/2 inches (800 mm) wide. Can be raised and lowered with one-hand. Produced from UHMW PE 1000 to be cut resistant while providing hammock for comfort. Surface shall be designed to be replaceable in the field.
k. Warranty: Three year limited warranty on parts; one year on labor.
l. Electrical: The unit shall operate at 24V / via 120V wall outlet. It shall include a grounded power cord and have a splash proof control system rated at IPX4.

3. Color: As selected by Architect from manufacturer’s full line
4. Dimensions: 75-5/16 inches long by 60-15/32 inches high by 40-9/32 (open) 9-23/32 (closed) inches deep.
5. Basis of Design: Koala Kare Changing Stations, Model KB3000-AHL, manufactured by Koala Kare Products, a division of Bobrick.
6. Location: Where indicated on Drawings.

U. TA-17R - Trash Receptacle, Recessed:
1. Mounting: Recessed.
2. Basis of Design: Bobrick B-3644.
3. Locations: As indicated on Drawings.

V. TA-17U - Trash Receptacle Undercounter:
1. Mounting: Free standing.
2. Basis of Design: Bobrick B-2280.

3. Locations: As indicated on Drawings.

W. TA-18 - Vertical Grab Bar:
   1. Mounting: Surface.
   2. Basis of Design: Bobrick B-6806x18.
   3. Locations: As indicated on Drawings.

X. TA-19 – Water Closet Cover Dispenser:
   1. Mounting: Recessed.
   2. Basis of Design: Bobrick B-301.
   3. Locations: At each water closet.

Y. TA-20 - Folding Utility Shelf:
   1. Mounting: Surface.
   2. Basis of Design: Bobrick B-287.
   3. Locations: At each toilet compartment.

Z. TA-21 - Hand Sanitizer:
   1. Mounting: Surface.
   2. Basis of Design: Bradley Model 6A02-11.
   3. Locations: As indicated on Drawings.

END OF SECTION 10 28 00

SECTION 10 43 00 - EMERGENCY AID SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Automated external defibrillator (AED) cabinets.

B. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 DEFINITIONS

A. Automated External Defibrillator (AED): A Food and Drug Administration (FDA)-approved portable device, which automatically analyzes the heart rhythm and recognizes the presence of ventricular fibrillation and/or tachycardia. If defibrillation is warranted, the AED automatically charges and prompts (visual and/or audio) the operator to deliver an electrical shock.

1.4 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide AED operational features, color and finish, anchorage details, and installation instructions.

C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Maintenance Data: Include test schedules and recertification requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

1. Emergency Aid Cabinets and Accessories:
   a. Activar Construction Products Group, Inc. - JL Industries; LifeStart 1400 Series AED Cabinet: www.activarcpg.com/#sle.
   b. Modern Metal Products, a division of Technico, Inc: www.modern-metal.com/#sle.

2.2 EMERGENCY AID CABINETS

A. Type: Automated external defibrillator (AED).

B. Cabinet Construction: Non-fire-rated.

C. Fire-Rated Cabinet Construction: One-hour fire rated.

1. Steel; double wall or outer and inner boxes with 5/8 inch (15.9 mm) thick fire barrier material.
2. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

D. Cabinet Configuration: Recessed, Semi-recessed, or Surface-mounted type as indicated on Drawings..
   1. Size each cabinet to accommodate AED as indicated on Drawings.
   2. Trim:
      a. At Recessed Cabinets: Flat square edge, with ____ inch (____ mm) wide face.
   3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

E. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with wire pull handle and nylon catch. Hinge door for 180 degree opening with two butt hinges.

F. Door Glazing: Tempered glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.

G. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.

H. Fabrication: Weld, fill, and grind components smooth.

I. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.

J. Finish of Door Pull or Handle: Stainless steel.

K. Finish of Cabinet Interior: White powder coat.

2.3 ACCESSORIES

A. Cabinet Door Signage: "AED" decal, as required, or vinyl self-adhering, prespaced black lettering and identifying graphic in accordance with authorities having jurisdiction (AHJ).

B. Plastic Wall Signage: Flat style.

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. Wall Signs:
   1. Location: Where indicated on Drawings.
   2. Apply on walls after field painting is completed and has been accepted.

B. Cabinet Lettering:
   1. Location: Face of door framing.

3.3 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust doors to operate smoothly without binding.

C. On completion of installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes. Replace products that cannot be restored to factory-finished appearance. Use materials and procedures recommended by cabinet manufacturer.

END OF SECTION 10 43 00

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire extinguisher cabinets.
   2. Accessories.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
   2. Section 09 90 00 - Painting and Coating: Field paint finish.

1.2 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

C. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

E. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

F. FM (AG) - FM Approval Guide; Current Edition.

G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

J. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.

C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinquishers, mounting measurements for wall bracket, installation procedures, and accessories required for complete installation.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.4 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Fire Extinguisher Cabinets and Accessories:

a. JL Industries, an Activar Construction Products Group, Inc. brand: www.activarcpg.com/#sle.
b. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
c. Larsen's Manufacturing Co., a member of Morris Group International: www.larsensmfg.com/#sle.
d. Nystrom, Inc: www.nystrom.com.
e. Oval Fire Products: www.ovalfireproducts.com.
f. Potter-Roemer, a member of Morris Group International: www.potterroemer.com/#sle.

2.2 DESCRIPTION

A. Regulatory Requirements:
1. Accessibility:
a. Americans with Disabilities Act of 1990, as amended:
1) ADA Title II Regulations & the 2016 ADA Standards for Accessible Design.
2. Building Code:
a. Comply with applicable requirements of International Building Code ICC (IBC).
3. Fire Code:
a. Comply with applicable requirements of International Fire Code ICC (IFC).
4. Welding Qualifications: Qualify procedures and personnel according to the following:
a. Aluminum: AWS D1.2/D1.2M.
b. Sheet Steel: AWS D1.3/D1.3M.
c. Stainless Steel: AWS D1.6/D1.6M.
d. Steel: AWS D1.1/D1.1M.

2.3 FIRE EXTINGUISHERS

A. Existing fire extinguisher for reuse:
1. Verify fire extinguisher is in good working order prior to installation. If not, notify Owner.

2.4 FIRE EXTINGUISHER CABINETS

A. Existing fire extinguisher cabinet for reuse:
1. Verify fire extinguisher cabinet is in good working order prior to installation. If not, notify the Owner.

B. Basis of Design: Alta Series as manufactured by Potter Roemer.

C. General:
1. Size to accomodate indicated extinguisher and accessories.
2. Doors:
a. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.
b. Door Glazing: Tempered glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
3. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
4. Fabrication: Weld, fill, and grind components smooth.
5. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
6. Finish of Cabinet Interior: White enamel.

D. Standard Cabinet Construction:
1. Non-fire-resistance-rated.
2. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.
3. Formed aluminum; ____ inch (____ mm) thick base metal.

E. Cabinet Configuration: Partially-Recessed.
1. Trim: Flat square edge, with 1/2 inch wide face.

2.5 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Locate as indicated on Drawings, as directed by the Owner, and as follows:
   1. Provide a minimum of one Multipurpose Fire Extinguisher for each 6,000 sq. ft (557 sq. m), or part thereof, in the project scope, per NFPA 10 Table 6.2.1.1 or as indicated on Drawings, whichever is greater.
   2. Provide one Multipurpose Fire Extinguisher with wall bracket in each of the following locations:
      a. Mechanical Rooms.
      b. Electrical Rooms.
      c. MDF/IDF/Telecommunications Rooms.
      d. Fire Riser Rooms.
      e. Auditoriums of 4000 square feet or less.

B. Install in accordance with manufacturer's instructions.

C. Install cabinets plumb and level in wall openings, such that it complies with accessibility requirements.

D. Secure rigidly in place.

E. Place extinguishers in cabinets.

F. Position cabinet signage at _____.

3.3 MAINTENANCE

A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for specified maintenance service.

C. Provide a separate maintenance contract for the service and maintenance of _____ for _____ years from Date of Substantial Completion.

END OF SECTION 10 44 00

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SECTION 10 51 13 - METAL LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal lockers.

B. Locker benches.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete base construction.

B. Section 06 10 00 - Rough Carpentry: Wood base construction.

C. Section 06 10 00 - Rough Carpentry: Wood blocking and nailers.

D. Section 06 20 00 - Finish Carpentry: Bench tops for locker bench support brackets.

1.3 REFERENCE STANDARDS

A. {RSTEMP#undefined}

B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2024b.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.

E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

F. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).

G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
   1. Wired Access Control: Include power requirements and standard wiring diagrams for specified products.

C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
   1. Wired Access Control: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

D. Full Size Sample: One full-size locker of each construction specified for evaluation of construction.

E. Samples: Submit two samples 6 inches by 6 inches in size showing color and finish of metal locker material.

F. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Art Metal Products: www.artmetalproducts.com.

2. ASI Storage Solutions: www.asi-storage.com.
3. DeBourgh Manufacturing Co: www.debourgh.com.
4. List Industries, Inc: www.listindustries.com.
5. Lockers MFG: www.lockersmfg.com.
6. Lyon Workspace Products: www.lyonworkspace.com.
7. Republic Storage Systems Co: www.republicstorage.com.
8. Tennsco Storage: www.tennsco.com.
9. WEC Manufacturing: www.itswec.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 LOCKER APPLICATIONS

A. Student Lockers Type 'D': Metal lockers, free-standing for base indicated on Drawings.
1. Width: 18 inches.
2. Depth: 18 inches.
3. Height: 72 inches.
4. Configuration: Single tier.
5. Fittings: Size and configuration as indicated on drawings.
6. Ventilation: Louvers at top and bottom of door panel.
7. Locking: Padlock hasps, for padlocks provided by Owner.
   a. Locking Action: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
8. Color: To be selected from manufacturer's full range by Architect.

B. Student Lockers Type 'F': Metal lockers, free-standing for base indicated on Drawings.
1. Width: 18 inches.
2. Depth: 18 inches.
3. Height: 72 inches.
4. Configuration: Two tier.
5. Ventilation: Louvers at top and bottom of door panel.
6. Locking: Padlock hasps, for padlocks provided by Owner.
   a. Locking Action: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
7. Color: To be selected from manufacturer's full range by Architect.

C. Varsity Lockers - Type 'A': Metal lockers, free-standing for base indicated on Drawings.
1. OFCI
2. Width: 34 inches.
3. Depth: 22 inches.
4. Height: 72 inches.
5. Configuration: Single tier.
6. Ventilation: Perforated side panels and doors.
7. Locking: Padlock hasps, for padlocks provided by Owner.
   a. Locking Action: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
8. Provide sloped top.
9. Color: To be selected from manufacturer's full range by Architect.

D. Varsity Lockers - Type 'B': Metal lockers, free-standing for base indicated on Drawings.
1. Width: 34 inches.
2. Depth: 22 inches.
3. Height: 72 inches.
4. Configuration: Single tier.

5. Ventilation: Perforated side panels and doors.
6. Locking: Padlock hasps, for padlocks provided by Owner.
   a. Locking Action: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
7. Provide sloped top.
8. Color: To be selected from manufacturer's full range by Architect.

E. Open-Front Turnout Gear Lockers Type 'C': Metal lockers, free-standing.
1. Width:12 inches.
2. Depth: 15 inches.
3. Height: 15 inches.
4. Configuration: 5 tier.
5. Fittings: Size and configuration as indicated on drawings.
6. Ventilation: Perforated side panels, doors, and back panels.
7. Door Configuration: Pair, solid with standard horizontal louvers top and bottom.
8. Latching: Three-point, Cremone latching, with padlockable turn handle.
9. Locking: Padlock hasps, for padlocks provided by Owner.
   a. Locking Action: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
10. Color: To be selected from manufacturer's full range by Architect.

2.3 METAL LOCKERS

A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.

B. Locker Case Construction:
1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
   a. Assembly: Do not use bolts, screws, or rivets to assemble locker bodies.
   b. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
      1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
         (a) Uncoated.
         (b) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation G60/Z180.
         (c) Zinc-Iron-Alloy-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation A40/ZF120.
         (d) Zinc-Coated by the Electrolytic Process: Comply with ASTM A879/A879M, coating designation 30Z.
         (e) Perforations: Manufacturer's standard pattern of square holes.
      2) Expanded Steel Sheet: Made from ASTM A1008/A1008M carbon steel sheet and complying with ASTM F1267, Type II, expanded and flattened, style 3/4 - 16, with a minimum 70 percent open area.
         (a) Class 1, uncoated.
         (b) Class 2, hot-dip zinc-coated, galvanized or galvannealed.
      3) Body and Shelves: 16 gauge, 0.0598 inch (1.52 mm).
      4) Backs: 18 gauge, 0.0478 inch (1.21 mm).
      5) Base: 18 gauge, 0.0478 inch (1.21 mm).
         (a) Height: 4 inches (100 mm).
      6) Legs: Manufacturer's standard
         (a) Form by extending frame members.
         (b) Fabricate from 14 gauge, 0.0747 inch (1.90 mm) nominal thickness steel sheet specified above, welded to bottom of locker.

(c) Height: 6 inches (152 mm).

c. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
1) Door Frame: 16 gauge, 0.0598 inch (1.52 mm), minimum.

d. Where ends or sides are exposed, provide flush panel closures.

e. Provide filler strips where indicated or required, securely attached to lockers.

2. Standard-Duty, Knocked Down Construction: Made of formed sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.

a. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
(a) Uncoated.
(b) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation G60/Z180.
(c) Zinc-Iron-Alloy-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation A40/ZF120.
(d) Zinc-Coated by the Electrolytic Process: Comply with ASTM A879/A879M, coating designation 30Z.
(e) Perforations: Manufacturer's standard pattern of square holes.
2) Expanded Steel Sheet: Made from ASTM A1008/A1008M carbon steel sheet and complying with ASTM F1267, Type II, expanded and flattened, style 3/4 - 16, with a minimum 70 percent open area.
(a) Class 1, uncoated.
(b) Class 2, hot-dip zinc-coated, galvanized or galvannealed.
3) Body and Shelves: 24 gauge, 0.0239 inch (0.61 mm).
4) Backs: 24 gauge, 0.0239 inch (0.61 mm).
5) Base: 18 gauge, 0.0478 inch (1.21 mm).
(a) Height: 4 inch (100 mm).
6) Legs: Manufacturer's standard.
(a) Form by extending frame members.
(b) Fabricate from 14 gauge, 0.0747 inch (1.90 mm) nominal thickness steel sheet specified above, welded to bottom of locker.
(c) Height: 6 inches (152 mm).

b. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
1) Door Frame: 16 gauge, 0.0598 inch (1.52 mm), minimum.

c. Where ends or sides are exposed, provide flush panel closures.

d. Provide filler strips where indicated, securely attached to lockers.

C. Drawer Base with Bench:
1. Top, Bottom, Sides, Back, and Drawer: 16 gauge, 0.0598 inch (1.52 mm) sheet steel.
2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.
3. Integral self latching mechanism triggered by operation of wardrobe door.
4. Bench: Mixed hardwood.

D. Latches and Door Handles: Manufacturer's standard.
1. Latching Components: 300 Series Stainless Steel (ASTM A240/A240M).
2. Latching: Manufacturer's standard for locking arrangement selected.
a. Three-Point Lift Handle Gravity Latch: Pocket-mounted, provide for doors 18 inches (457 mm) or taller.
1) Handle Pocket, Recess: Stainless steel flush-mounted cup recessed into face of door.

2) Handle: Steel finger lift mechanism with exposed portion encased in molded plastic trigger.
   (a) Padlock Eye: Integral with lift trigger, sized for use with 9/32 inch (7.1 mm) diameter padlock shackles.
3) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.
4) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.
5) Rubber bumpers riveted to door stops for silent operation.

b. Three-Point Pull Handle Gravity Latch: Surface-mounted, provide for doors 18 inches (457 mm) or taller.
1) Handle: Steel finger lift mechanism.
2) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.
3) Padlock Eye: Integral with lift handle, sized for use with 9/32 inch (7.1 mm) diameter padlock shackles.
4) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.
5) Rubber bumpers riveted to door stops for silent operation.

c. Three-Point/Three-Sided Cremone Latch.
1) Latching mechanism operated by a steel handle welded to a three-point Cremone-type assembly.
2) Latching rods, 3/8 inch (9.5 mm) diameter, engage top and bottom edge of locker frame. 3/16 inch (4.8 mm) thick center latch engages door jamb.

d. Single-Point Latch: Provide for doors indicated.
1) Stationary latch welded securely to locker frame.
2) Latch extends no more than 1-1/4 inch (31.8 mm) into locker opening, penetrating through cup.
3) Flush-mounted, recessed stainless steel cup in a formed door with 18 gauge, 0.0478 inch (1.21 mm) vertical back panel stiffener.

e. Spring Latch: Provide for box-size lockers and where indicated.
1) 16 gauge, 0.0598 inch (1.52 mm) cold rolled steel, zinc plated with a 10 gauge, 0.1345 inch (3.42 mm) latch and 16 gauge, 0.0598 inch (1.52 mm) stainless steel lock hasp and completely enclosed stainless steel spring.
2) Assembled using six nickel-plated rivets.
3) Equip box locker doors with a padlock hasp and a stainless steel strike plate with an integral handle pull. Box locker doors may also be equipped with built-in locks.

f. Access Control Single-Point Latch: Provide for doors indicated.
1) Wireless integrated access control locking devices.
2) Stationary latch welded securely to locker frame.
3) Rubber bumpers riveted to door stops for silent operation.

E. Cup, Pocket: Manufacturer's standard, with integral pull, and recessed surface punched for installation of lock, latch lift mechanism, and number plate.

F. Hinges: Continuous piano hinge with powder coat finish to match locker color.

G. Hinges: Heavy-duty, 7-knuckle type; two for doors under 42 inches (1050 mm) high; three for doors over 42 inches (1 050 mm) high.

H. Sloped Top: 20 gauge, 0.0359 inch (0.91 mm), with closed ends.

I. Trim: 20 gauge, 0.0359 inch (0.91 mm).

J. Number Plates: Provide oval shaped aluminum plates. Form numbers 1 inch high of block font style with ADA designation, in contrasting color.

K. Locks: Locker manufacturer's standard type indicated in Applications article above.

L. RFID Lock System Components and Accessories: Manufacturer's standard.
1. Graphic user interface for central configuration, monitoring and management of locker system.
2. Locker management software with ability to generate audit trail: Logging all actions on the lock including date, time, lock status, RFID media type, and serial number in a centralized SQL database.
3. Programmable networked RFID locking device
4. Contactless RFID Media: Cards, wristbands, key fobs, and other NFC connected devices.
5. Power: Battery operated.
6. Connectivity: Wired.

M. Locker Groups: Gang lockers in groups of two and assemble in factory for shipment as a single unit.

2.4 LOCKER BENCHES

A. Locker Benches: Stationary type; bench top of laminated birch; painted steel pedestals.
1. Accessibility: Comply with ICC A117.1 and ADA Standards.
2. Height: _____ inch (_____ mm).
3. Length: _____ inch (_____ mm).

B. Locker Bench Support Brackets: Welded structural aluminum single arm floor mount pedestal bench support brackets; pre-drilled for bench top material attachment and for wall anchorage.
1. Accessibility: Comply with ICC A117.1 and ADA Standards.
2. Height: _____ inch (_____ mm).
3. Depth: _____ inch (_____ mm).
4. Load Capacity per Bracket: 400 pounds (181 kg).
5. Finish: Clear anodized.
6. Bracket Spacing: 36 inches on center (914 mm on center), maximum. Project-specific spacing to be determined based on field measurements.
7. Bracket-to-Wall Attachment: Fasteners/anchors recommended by bracket manufacturer for wall construction conditions encountered.
8. Products:
   a. Rakks/Rangine Corporation; Bench Support Brackets: http://www.rakks.com/#sle.
   b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

B. Verify bases and embedded anchors are properly sized.

C. Verify that power and ethernet are installed and enabled. See manufacturer drawings for recommended outlet or junction box placement.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.

C. Install lockers plumb and square.

D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).

E. Bolt adjoining locker units together to provide rigid installation.

F. Install end panels, filler panels, and sloped tops.

G. Install fittings if not factory installed.

H. Replace components that do not operate smoothly.

3.3 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION 10 51 13

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SECTION 10 56 13 - METAL STORAGE SHELVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Four post shelving.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Blocking and reinforcement in walls for anchoring shelving units.

B. Section 09 21 16 - Gypsum Board Assemblies: Blocking and reinforcement in walls for anchoring shelving units.

C. Section 10 56 26 - Mobile Storage Shelving: Installation of metal storage shelving on mobile carriages.

1.3 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

1.4 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. 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. Specimen warranty.
   8. Maintenance methods.

C. 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 of Texas, will be acceptable.

D. 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.

E. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and finishes.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 77 00 - Closeout Procedures, for additional provisions.
   2. Extra Shelves: Two of each size with shelf brackets.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of documented experience and approved by manufacturer.

1.6 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.

1.7 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

B. Provide one year manufacturer warranty covering defects of manufacturing and workmanship and rust and corrosion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
   1. Four Post Shelving:
      a. ASI Storage Solutions: www.asi-storage.com.
      b. Hallowell: www.hallowell-list.com.
      c. List Industries, Inc: www.listindustries.com/#sle.
      d. Montel; SmartShelf: www.montel.com/#sle.
      e. Penco Products, Inc: www.pencoproducts.com/#sle.
      f. SpaceSaver Corporation: www.spacesaver.com/#sle.
      g. Tennsco Storage; Z-Line Shelving: www.tennsco.com/#sle.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 SHELVING - GENERAL

A. Refer to Drawings for layout and sizes.

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. Refer to Drawings for additional details of anchorage.

2.3 FOUR POST SHELVING

A. Four Post Shelving: Steel post-and-beam or post-and-shelf type with sway bracing, shelving brackets, shelving surfaces, and accessories as specified.
   1. Unit Width: Refer to Drawings.
   2. Shelf Capacity: Uniform distributed load of 50 psf (2.4 kPa), minimum.
   3. Shelf Beam Capacity: 500 lbs (227 kg) per shelving bay.
   4. Shelf Depth: Refer to Drawings
   5. Unit Depth: Refer to Drawings.
   6. Clear Shelf Opening Height: Refer to Drawings.
   7. Shelves per Unit: As indicated on drawings.
   8. Unit Height: __ inches (__ mm)Refer to Drawings.
   9. Finish: Galvanized.
      a. Color: To be selected by Architect from manufacturer's standard range.
   10. Provide single-face and double-face units where indicated.
   11. Number of Units: As indicated on Drawings.

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 (3 mm) 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 Date of Substantial Completion.

END OF SECTION 10 56 13

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SECTION 10 71 13.43 FIXED SUN SCREENS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section Aluminum Sunshade Systems, including accessories, mountings, and shims. Sunshades are anchored directly to the vertical curtain wall or storefront mullions.

B. Related Sections:
1. 07 92 00: Joint Sealants
2. 08 41 13: Aluminum-Framed Entrances and Storefronts
3. 08 43 13: Aluminum-Framed Storefronts
4. 08 43 29: Sliding Storefronts
5. 08 44 13: Glazed Aluminum Curtain Walls
6. 08 51 13: Aluminum Windows
7. 08 80 00: Glazing

1.3 DEFINITIONS

A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance:
1. Combined load on sunshade configurations to be determined in accordance with ASCE 7 or applicable code requirements. Combined load consists of wind, snow and ice loads.
2. Design sunshade configurations to withstand stresses due to combined load. Stresses resulting from thermal expansion/contraction, shall not cause permanent deformation of sunshade assemblies or disengagement from the glazed system.
3. The assembled sunshade shall be capable of supporting the specified combined load without damage, permanent deformation, or disengagement from the glazed system mullion.
4. Blade deflection shall not exceed L/120 of span length.
5. Submit test reports verifying compliance with each test requirement required by the project.

B. Shading Performance:
1. Design of standard configurations will allow for negligible direct sunlight to show through the blades based on project location, latitude, altitude, building orientation, surrounding conditions, and aesthetic requirements, except for round, diamond and square louver styles.

C. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures.
   1. Temperature Change (Range): 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces.

1.5 SUBMITTALS

A. Product Data:
   1. For each type of product indicated, include:
      a. Construction details
      b. Material descriptions
      c. Dimensions of individual components and profiles
      d. Finishes
   2. Material Ingredient Reporting:
      a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.

B. Shop Drawings:
   1. Plans
   2. Elevations
   3. Sections
   4. Blade angles
   5. Blade spacing
   6. Attachments to other compatible systems work

C. Samples for Initial Selection:
   1. Provide samples for units with factory-applied color finishes.
   2. Provide samples of hardware and accessories involving color selection.

D. Samples for Verification:
   1. Provide a verification sample for each type of exposed finish required, in manufacturer's standard sizes.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer must have successfully installed the same or similar systemsrequired for the project and other projects of similar size and scope.

B. Manufacturer Qualifications:

C. Source Limitations:
   1. Obtain aluminum exterior sunshades and glazed aluminum curtain walls and storefront system through one source from a single manufacturer.

D. Product Options:

1. 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.
2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Mockups:
1. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

F. Pre-installation Conference:
1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.

1.7 PROJECT CONDITIONS

A. Field Measurements:
1. Verify actual locations of structural supports for sunshades by field measurements before fabrication.
2. Indicate measurements on shop drawings.

1.8 WARRANTY

A. Submit manufacturer's standard warranty for owner's acceptance.

B. Warranty Period:
1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Versoleil Sunshade – Outrigger System as manufactured by Kawneer Company, Inc. Other Manufacturers who have (5) experience and meet or exceed the requirements of products are eligible to follow substitution procedures for approval of use on the project.

2.2 MATERIALS

A. Aluminum Extrusions:
1. Alloy and temper recommended by glazed aluminum curtain wall and storefront manufacturer for strength, corrosion resistance, and application of required finish
2. Not less than 0.070" (1.8 mm) wall thickness at any location for the main frame
3. Complying with ASTM B221: 6063-T6 alloy and temper

B. Thermal Barrier:
   1. When applied on a thermally broken captured system, sunshade shall be thermally isolated from the interior aluminum mullions by a nominal 0.25" (6.3) thick low conductance material.

C. Aluminum Sheet Alloy:
   1. Shall meet the requirements of ASTM B209.

D. Sealant:
   1. For sealants required within fabricated sunshade system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

E. Tolerances:
   1. References to tolerances for wall thickness and other cross-sectional dimensions of glazed curtain wall and storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 SUNSHADES

A. Sunshade Members:
   1. Manufacturer's standard extruded or formed-aluminum framing members of thickness and reinforced as required to support imposed loads.

B. Fasteners and Accessories:
   1. Nonmagnetic stainless steel to be non-corrosive and compatible with aluminum members, anchors, and other components.

C. Perimeter Anchors:
   1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

D. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

E. Storage and Protection:
   1. Store materials so that they are protected from exposure to harmful weather conditions.
   2. Handle material and components to avoid damage.
   3. Protect material against damage from elements, construction activities, and other hazards before, during, and after installation.

2.4 ACCESSORY MATERIALS

A. Bituminous Paint:
   1. Cold-applied asphalt-mastic paint
   2. Complies with SSPC-Paint 12 requirements except containing no asbestos
   3. Formulated for 30-mil (0.762 mm) thickness per coat

2.5 FABRICATION

A. Extrude or form aluminum shapes before finishing.

B. 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 that are flush, hairline, and weatherproof
   3. Physical and thermal isolation of glazing from framing members
   4. Accommodations for thermal and mechanical movements of glazing and framing that maintain required glazing edge clearances
   5. Fasteners, anchors, and connection devices that are concealed from view to the greatest extent possible

C. Sunshade:
   1. Fabricate components for assembly using manufacturer’s standard installation instructions.

D. After fabrication, clearly mark components to identify their locations in project according to shop drawings.

2.6 ALUMINUM FINISHES

A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:
   1. Color Anodized, Black .

PART 3 EXECUTION

3.1 EXAMINATION

A. With installer present, examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Proceed with installation only after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions. Refer to installation instructions of the compatible curtain wall or storefront system.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure non-movement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

7. Seal joints watertight where shown on approved shop drawings and/or manufacturer's standard installation instructions.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components plumb and true in alignment with established lines and grades.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:
   1. Protect installed product’s finish surfaces from damage during construction.
   2. Protect aluminum sunshade system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants

C. Cleaning:
   1. Repair or replace damaged installed products.
   2. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance.
   3. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
   4. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 10 71 13.43

SECTION 11 21 73 - COMMERCIAL LAUNDRY AND DRY CLEANING EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Laundry equipment.
   2. Appliance coordination including service connections, supply lines, and power.
   3. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical data including product specifications and installation and maintenance instructions.

B. Product Certificates: Submit certificate from product manufacturer stating compliance with requirements and intended use of product.

C. Warranties: Submit manufacturer warranty indicated product is warranted in a light commercial application.

D. Operation and Maintenance Data: Submit for each residential appliance to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   2. UL and NEMA: Provide electrical components required as part of light commercial appliances listed and labeled by UL and complying with applicable NEMA standards.
   3. Energy Ratings: Provide energy efficient appliances that carry labels indicating energy cost analysis (estimated annual operating costs) and efficiency information.
   4. Accessibility Requirements: Comply with applicable requirements.
      a. S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Source Limitations: Obtain light commercial appliances from single source and each type of light commercial appliance from single manufacturer.

C. Pre-Installation Conference: Conduct conference at site.

1.5 WARRANTY

A. Warranties: Written warranty signed by manufacturer in which laundry equipment manufacturer agrees to repair or replace appliances or components that fail in materials or workmanship within specified warranty period.
   1. Provide appliance and equipment rated for light commercial grade or higher. Residential appliances are not acceptable unless manufacturer specifically warrants residential units in a commercial application and only with Architect’s approval.

B. Clothes Washer: Full warranty, including parts and labor, for onsite service on the product.
   1. Warranty Period: Three years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 LAUNDRY EQUIPMENT

A. Product Options: Information on Drawings and in Specifications establishes requirements for product's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

B. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
   1. Washing Machine:
      a. Continental.
      b. General Electric.
      c. UniMac.
      d. Speed Queen.
   2. Tumble Dryer:
      a. Continental.
      b. General Electric.
      c. UniMac.
      d. Speed Queen.
   3. Laundry Carts:
      a. Dandux.

C. Washer-Extractor:
   1. Basis of Design: Continental Girbau L1075 Front Loader Washer Extractor.
   2. Capacity: 75 lbs (32 kg).
   3. Dimensions:
      a. Width: 43 inches (1093 mm).
      b. Height: 57 inches (1440 mm).
      c. Depth: 46 inches (1163mm).
   4. Cylinder Diameter: 35.5 inches (900 mm).
   5. Cylinder Depth: 20 inches (500 mm).
   6. Cylinder Volume: 11.2 cu. ft. (318 liters).
   7. Door Opening Size: 21.6 inches (549 mm).
   8. Washing Speed (RPM): 40.
   9. Spin Speed (RPM): 510.
   10. G Force: 131.
   11. Water Inlet Connection: 3/4 inch (19 mm).
   12. Drain Diameter: 3 inch (76 mm).
   13. Water Flow: 16 gallons per minutes (60 liters per minute)
   14. Voltage/Hz # of Wire/Phase: 208-240/60/3, 3W+G, 25.
   15. Power Consumption: (2.7 kW).
   16. Finish: Stainless steel.

D. Tumble Dryer:
   1. Basis of Design: Continental Girbau CG75-85 Pro Series II Commercial Dryer.
   2. Capacity: 85 lbs.
   3. Drum: Perforated stainless steel.
      a. Diameter: 37 inches (940 mm).
      b. Depth: 36 inches (914 m).

c. Volume: 22.4 cu/ft. (0.638 cu/m).
4. Dimensions:
a. Width: 38.62 (981 mm).
b. Depth: 54.25 (1378 mm).
c. Height: 76.62 (1946 mm).
5. Motor: 3/4 hp (0.56 kW).
6. Door Opening: 26.89 inches (683 mm)
7. Exhaust Connection: 8 inches (200 mm).
8. Exhaust Air Flow: 750 (354 l/s).
9. Controls: Touch pad controls for drying cycle, temperatures, and fabric selectors.
10. Features:
a. Removable lint filter.
b. Electronic temperature and moisture level sensor controls.
c. End of cycle signal.
d. Interior drum light.
e. Self-leveling legs.
f. Sensor activated fire extinguishing system.
11. Voltage/Hz # of Wire/Phase: 200-208v/60 hz/1.
12. Finish: Stainless steel.

E. Laundry Carts : Ten bushel, yellow glosstex carts.
1. Basis of Design: Dandux Model 40-720CG.
2. Quantity: Three.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and conditions affecting performance of work. Coordinate installation of equipment, appliances, fixtures, and other items.
1. Examine roughing in for piping systems and verify actual locations of piping connections before equipment installation.
2. Examine electrical circuits and rating and verify locations and sufficient ratings for items requiring electrical power.
3. Examine space to receive items and verify the space is of sufficient size and configuration for items.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions. Install fixtures level and plumb according to roughing in drawings.

B. Power Supply: Coordinate power supply, grounding, outlets, and electrical wiring with locations indicated for appliances and equipment.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities: Refer to plumbing and electrical sections for plumbing, venting, and electrical requirements.

E. Connections and Hook ups: Coordinate location of services.
1. Grounding: Ground equipment in accordance with applicable standards and code requirements.
2. Wiring: Connect wiring in accordance with manufacturer recommendations.
3. Provide necessary electrical outlets.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory authorized service representative:
   1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturer written recommendations. Certify compliance with each manufacturer appliance performance parameters.
   2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After installation, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare and submit test and inspection reports.

D. Test each equipment item to verify proper operation. Make necessary adjustments. Replace malfunctioning appliances and components, then retest. Repeat procedure until units operate properly.

3.4 CLEANING

A. Clean equipment with manufacturers' recommended cleaning methods and materials. After completing installation of equipment and fixtures, inspect exposed finishes and repair damaged finishes. Remove packing materials from site.

3.5 PROTECTION

A. Provide protective covering for installed appliances. Do not allow use of equipment items for temporary facilities.

END OF SECTION 11 21 73

SECTION 11 30 13 - RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Kitchen appliances.

B. Related Sections:
   1. Division 22 - Plumbing: Plumbing connections for appliances.
   2. Division 23 - Mechanical: Exhaust connections for appliances.
   3. Division 26 - Electrical: Electrical connections for appliances.

1.2 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.

C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

C. Gas Appliances: Bearing design certification seal of American Gas Association (AGA).

1.5 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.

C. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.

D. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Broan-NuTone, LLC.: www.broan-nutone.com.
   2. Frigidaire Home Products: www.frigidaire.com.
   3. Whirlpool Corp: www.whirlpool.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 KITCHEN APPLIANCES

A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.

B. Refrigerator: Free-standing, side-by-side, and frost-free.
   1. Capacity: Total minimum storage of 18 cubic ft (0.51 cu m); minimum 15 percent freezer capacity.

2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by U.S. Department of Energy (DOE).
3. Features: Include glass shelves, automatic icemaker, light in freezer compartment, and in-door water and ice dispenser.
4. Exterior Finish: Porcelain enameled steel, color as selected by Architect from manufacturer's full line.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor built-in equipment in place.

3.3 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.4 CLEANING

A. Remove packing materials from equipment and properly discard.

B. Wash and clean equipment.

END OF SECTION 11 30 13

SECTION 11 46 83 - ICE MACHINES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Commercial ice machines
   2. Appliance coordination including service connections, supply lines, and power
   3. Accessories necessary for a complete installation

B. Related Sections:
   1. Division 22: Domestic water supply.
   2. Division 26: Electrical connection.

1.3 SUBMITTALS

A. Product Data: Technical data including product specifications, installation, and maintenance instructions.

B. Product Certificates: Submit certificate from product manufacturer stating compliance with requirements and intended use of product.

C. Operation and Maintenance Data: Submit for each residential appliance to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
   3. Energy Ratings: Provide energy efficient appliances that carry labels indicating energy cost analysis (estimated annual operating costs) and efficiency information.
   4. Accessibility Requirements: Comply with applicable requirements.
      a. United States Access Board Americans with Disabilities Act Accessibility Guidelines (ADAAG) (2010 ADA Standards for Accessible Design).
      b. ICC A117.1 Accessible and Useable Building and Facilities.

B. Product Options: Information on Drawings and in Specifications establishes requirements for product's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

C. Source Limitations: Obtain light commercial appliances from single source and each type of light commercial appliance from single manufacturer.

D. Preinstallation Conference: Conduct conference at site.

1.5 WARRANTY

A. Warranties: Written warranty signed by manufacturer in which manufacturer of the specific appliance specified agrees to repair or replace appliances or components that fail in materials or workmanship within specified warranty period.

1. Provide appliance and equipment rated for light commercial grade or higher. Residential appliances are not acceptable unless manufacturer warrants residential units in a commercial application and only with Architect's approval.

B. Icemaker, Sealed System: Full warranty, including parts and labor, for onsite service on the product.
   1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
   2. Warranty Period for Other Components: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Follet.

B. Scotsman.

C. Hoshizaki.

2.2 APPLIANCES

A. Ice Machine (ICE1):
   1. Basis of Design: Model DCM-500BAH as manufactured by Hoshizaki.
   2. Dimensions: 26 inches wide by 40 inches high.
   3. Finish: Stainless Steel.
   4. Ice Production: Up to 535 lbs per 24 hrs.
   5. Built in Storage Capacity: 40 lb.
   6. Refrigerant: R404A.
   7. Electrical: 12 amps.
   8. Cube Type: Cublet.
   9. Stainless steel evaporator, auger, top bearings, heavy duty tapered roller bearings, and low water safety circuit. NSF, ETL and CE listed depending on voltage requirement.
   10. Accessories: Ice scoop and related accessories necessary for a complete installation and use.

B. Ice Machine (ICE2):
   1. Basis of Design: Model DKM-901MAJ as manufactured by Hoshizaki.
   2. Dimensions: 30 inches wide by 32.50 inches high.
   3. Finish: Stainless Steel.
   4. Ice Production: Up to 905 lbs per 24 hrs.
   5. Refrigerant: R404A.
   6. Electrical: 13 amps.
   7. Cube Type: Crescent.
   8. Stainless steel evaporator, auger, top bearings, heavy duty tapered roller bearings, and low water safety circuit. NSF, ETL and CE listed depending on voltage requirement.
   9. Accessories: Ice scoop and related accessories necessary for a complete installation and use.

C. Ice Machine (ICE3):
   1. Basis of Design: Model KML-700MAJ as manufactured by Hoshizaki.
   2. Dimensions: 30 inches wide by 26 inches high.
   3. Finish: Stainless Steel.
   4. Ice Production: 721 lbs per 24 hours.
   5. Refrigerant: R404A.
   6. Electrical: UL listed, 115V, 60 Hz, 1 phase; 14.3 amp; provide minimum 7 foot cord and NEMA 5-15 plug with each ice maker.
   7. Cube Type: Crescent
   8. Stainless steel evaporator, auger, top bearings, heavy duty tapered roller bearings, and low water safety circuit. NSF, ETL and CE listed depending on voltage requirement.

9. Accessories: Ice scoop and related accessories necessary for a complete installation and use.

D. Ice Bin (BIN1):
1. Basis of Design: Model B-800SF as manufactured by Hoshizaki.
2. Dimensions: 48 inches wide by 46 inches high.
3. Finish: Stainless Steel.
4. Storage Capacity: 800 lb.
5. Plumbing: 3/4 inch FPT drain.

E. Ice Bin (BIN2):
1. Basis of Design: Model B-500SF as manufactured by Hoshizaki.
2. Dimensions:30 inches wide by 46 inches high.
3. Finish: Stainless Steel.
4. Storage Capacity: 500 lb.
5. Plumbing: 3/4 inch FPT drain.

F. Appliances, Equipment, and Fixtures: Coordinate equipment, fixtures, appliances regardless which party provides or furnishes. Ensure adequate power supply and properly locate plumbing lines and hook ups, water and drain connections and accessories.

G. Accessories: Provide accessories necessary for a working installation.

2.3 FINISHES

A. Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Stainless Steel Finish: Provide appliances with standard finish complying with manufacturer's written instructions for surface preparation including ground and polished stainless steel surfaces for uniform, directionally textured finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and conditions affecting performance of work. Coordinate installation of equipment, appliances, fixtures, and other items.
1. Examine roughing in for piping systems and verify actual locations of piping connections before equipment installation.
2. Examine electrical circuits and rating and verify locations and sufficient ratings for items requiring electrical power.
3. Examine space to receive items and verify the space is of sufficient size and configuration for items.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions. Install fixtures level and plumb according to roughing in drawings.

B. Power Supply: Coordinate power supply, grounding, outlets, and electrical wiring with locations indicated for appliances and equipment.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities: Refer to plumbing and electrical sections for plumbing and electrical requirements.

E. Connections and Hook ups: Coordinate location of services.

1. Grounding: Ground equipment in accordance with applicable standards and code requirements.
2. Wiring: Connect wiring in accordance with manufacturer recommendations.
3. Provide necessary electrical outlets.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory authorized service representative:
   1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturer written recommendations. Certify compliance with each manufacturer appliance performance parameters.
   2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After installation, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Test each equipment item to verify proper operation. Make necessary adjustments. Replace malfunctioning appliances and components, then retest. Repeat procedure until units operate properly.

3.4 CLEANING

A. Clean equipment with manufacturers' recommended cleaning methods and materials. After completing installation of equipment and fixtures, inspect exposed finishes and repair damaged finishes. Remove packing materials from site.

3.5 PROTECTION

A. Provide protective covering for installed appliances. Do not allow use of equipment items for temporary facilities.

3.6 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 11 46 83

SECTION 12 11 13 - PHOTO MURALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Very large scale vinyl wall graphics (murals) digitally printed on self-adhesive vinyl graphics film from electronic graphic image files furnished by the Architect, adhered to gypsum board surfaces with a Level 5 skim coated, smooth painted finish.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Installation drawings: Indicate configuration and dimensions of substrate(s) including (if applicable) penetrating and protruding elements; vinyl mural panels; seam locations; details of installation; and related and adjacent work. Note field-measured dimensions.

B. Product Data:
   1. Manufacturers' specifications for vinyl film medium, inks and laminating film, and other data sufficient to demonstrate compliance with specified requirements
   2. Manufacturer’s written preparation, installation, and cleaning and maintenance instructions and recommendations

C. Samples:
   1. Color Approval Proof:
      a. Full color laminated print produced with the same equipment that will be used for the actual vinyl wall graphics panels, using the specified resolution, ink sets, vinyl film printing medium and clear protective laminating film, in a size proportional to the finished mural, with the lesser dimension approximately equal to the width of the vinyl film medium.
      b. Make adjustments, reprint and resubmit as necessary to obtain Architect's approval.

D. Certificates: Submit written certification, on graphics provider firm's letterhead, that products and installation comply with specified requirements.

1.4 ENVIRONMENTAL CONDITIONS

A. Maintain room and substrate temperature and humidity within the ranges recommended by the graphic film manufacturer at least 48 hours prior to, during, and after installation, until Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, handle and store products as recommended by the manufacturer(s), in graphics provider's labeled protective packaging. Protect from damage and deterioration.

1.6 WARRANTY

A. Graphics provider shall provide a 10-year material and labor warranty against fading, edge lifting, peeling, discoloration, delamination of the overlaminate from the vinyl graphics film, and delamination of the vinyl film from the painted Level 5 skim-coated smooth-painted gypsum board substrate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS, MANUFACTURERS AND GRAPHICS PROVIDERS

A. Specifications are based on products, manufacturers and graphics providers named herein or listed as the Basis of Design. Products of manufacturers listed which meet or exceed specifications are approved for use on the Project. Other manufacturers and graphics providers must have a minimum of five (5) years experience supplying (and for graphics providers,

installing) products meeting or exceeding the specifications, and comply with requirements of Section 01 25 13 Product Substitution Procedures to be considered.

2.2 GRAPHICS PROVIDER

A. Basis of Design: Riot Creative Imaging division of ARC (Dana LaPointe), 6300 Gulfton, Houston, TX 77081; 713-830-3933; dana.lapointe@riotcolor.com; www.riotcolor.com

B. Other Approved Manufacturer: Mountain Commercial Graphics; (713) 996-6634.

C. Single-source Responsibility: Graphics Provider shall be solely responsible for processing, production and installation, whether installation is performed by its own personnel or by its approved installation contractor.

2.3 EQUIPMENT

A. Basis of Design Printer: HP 3000 grand format inkjet printer with HP 881 Latex Printheads; 54 inch wide media capacity; 600 dpi minimum resolution, or equivalent equipment acceptable to the Architect and compatible with the specified (or approved substitution) inks and media.

B. Laminator: Compatible with the specified (or approved substitution) vinyl film media, inks and overlaminate.

2.4 MATERIALS

A. Basis of Design for VWC-Drywall Application:

B. Protective Laminated Film: ClearShield Wall Armor film. Category V Type II.
   1. Colorfastness: Greater than or equal to 200h.
   2. Washability: Greater than or equal to 100 cycles.
   3. Scrubbability: Greater than or equal to 300 cycles.
   4. Abrasion Resistance: Greater than or equal to 300 cycles.
   5. Cracking, Drying: Good.
   6. Stain Resistance to Reagents: 4.
   7. Flame Spread: Less than or equal to 25.

C. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
   1. Curing: Heat and infrared cured
   2. VOCs: Less than 294 g/L
   3. Hazardous Air Pollutants (HAPs): None.
   4. Hazard Warning Labels: None (cautionary only; no "R" phrases).
   5. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C

D. Vinyl Wall Covering: Dreamscape Suede.
   1. Description: Commercial grade vinyl printable vinyl wallcovering media for modern wide format inkjet printers.
   2. Construction: Embossed vinyl face with laminated fabric backing.
   3. Backing: Poly-cotton woven or polyester/pulp non-woven.
   4. Type Properties: Passes all criterion for WA 101, Type II.
   5. Thickness: 0.017 in.

E. Accessory products, tools, and equipment: Recommended by, or acceptable to, the manufacturers of the materials with which they are used.
   1. Basis of Design for CMU Application:

F. Vinyl Graphics Film: 3M™ "IJ180Cv3-10 Controltac™ Graphic Film" cast vinyl film suitable for inkjet printing. Calendared films are not acceptable.
   1. Film Thickness: 0.05 mm (2 mil, 0.002 inch)
   2. Surface: Smooth, white, opaque and glossy.
   3. Applied shrinkage: < 0.1 mm per FTM 14.

4. Adhesive: Factory-applied 3M "Comply™ v3" solvent acrylic pressure-sensitive repositionable adhesive with air release channels, protected by double-sided polyethylene coated paper, for dry application only, for permanent, non-removable installation.
    a. Adhesion: Approximately 18 N/25 mm per FTM 1 (180 degree peel, glass, 24h, 23 degrees C, 50 percent RH)

G. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
1. Curing: Heat and infrared cured
2. VOCs: Less than 294 g/L
3. Hazardous Air Pollutants (HAPs): None.
4. Hazard Warning Labels: None (cautionary only; no "R" phrases).
5. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C

H. Protective Laminating Film: 3M™ "Envision™ Luster Wrap Overlaminate 8548L" cast film. Calendared films are not acceptable.
1. Luster high performance non-PVC film
2. Exceptional conformability and lifting resistance
3. Less prone to scratching
4. Superior UV and acid dew protection
5. Longer term vertical durability
6. Horizontal warranty

2.5 PROCESSING AND PRODUCTION

A. Lay out each mural image in full-height vertical panels without horizontal seams. Allow overlap at vertical seams for accurate alignment and trimming. Unless otherwise specifically authorized by the Architect, lay out so panels are equal in width and arranged symmetrically. In no case shall a panel be less than one-half the vinyl media width.

B. For uniform appearance, produce all panels using vinyl film media, inks, and laminating film that are each sourced from a single manufacturing lot or production run.

C. Each panel shall be free from skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint as many panels as necessary for flawless appearance and consistent color match between all panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. With the installer, examine the conditions affecting work of this section, including but not necessarily limited to substrate surface smoothness, cleanliness, and uniformity; adjacent materials; and temperature and humidity.
1. Confirm that substrate surfaces are properly finished, smooth, and clean, and are free of contaminants, texture, roughness, voids, protrusions and other surface irregularities that could impair adhesion or telegraph through the applied film.
2. Report unsatisfactory conditions to the Architect in writing.
3. Do not proceed with installation until unsatisfactory conditions have been corrected. Commencement of installation shall be deemed to be acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Acclimatize printed vinyl film and other materials to the environment where they will be installed for at least 24 hours prior to commencement of installation, or for a longer period if recommended by the manufacturer.

B. Prior to installation, re-inspect mural panels closely for skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint and replace as many panels as necessary for flawless appearance and consistent color match between all panels.

3.3 INSTALLATION

A. Digitally-Printed Vinyl Murals:
   1. Installation shall be performed only by trained, experienced personnel approved by the graphics provider.
   2. Install in accordance with manufacturer’s instructions and reviewed submittals.
   3. Install in location(s) shown on drawings
   4. Seams: Hairline, with overlapped, razor-cut butt joints. Visually align adjacent panels for accurate registration with no visible gaps, offsets or misalignments.
   5. Install without bubbles, wrinkles, gaps, fish mouths and other surface and seam irregularities for a smooth, uniform appearance.

3.4 CLEANING AND PROTECTION

A. Protect installed work from deterioration and other damage as recommended by the manufacturer until date of Substantial Completion.

B. If necessary and possible, clean or repair murals to restore to like-new condition following manufacturer's written instructions and recommendations.

C. Replace materials found to be defective or damaged, if it is not possible to clean or restore them to like-new condition.

D. Clean and repair damaged adjacent surfaces and other work damaged by the work of this section. If damage cannot be cleaned or repaired to the equivalent of new condition (or for existing materials, their condition prior to damage from construction), replace damaged materials with new undamaged materials.

END OF SECTION 12 11 13

SECTION 12 21 13 - HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Horizontal slat louver blinds.
   2. Operating hardware.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.3 REFERENCE STANDARDS

A. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the placement of concealed blocking to support blinds. Refer to Section 06 10 00 - Rough Carpentry.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data indicating physical and dimensional characteristics.

C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.

D. Samples: Submit two samples, 6 inch (150 mm) long illustrating slat materials and finish, cord type and color.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 60 00 - Product Requirements for additional provisions.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Horizontal Louver Blinds:
      a. Draper, Inc; www.draperinc.com.
      b. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
      c. Levolor: www.levolor.com/commercial.
      d. Springs Window Fashions (SWF)contract, a division of Springs Window Fashions, LLC: www.swfcontract.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

C. Source Limitations: Furnish blinds and associated controls produced by a single manufacturer and obtained from a single supplier.

2.2 BLINDS WITHOUT SIDE GUIDES

A. Basis of Design:
   1. CD80 manufactured by Hunter Douglas Architectural.

B. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail complying with WCMA A100.1.

C. Manual Operation: Control of raising and lowering by cordless-mechanism; blade angle adjustable by control wand.

D. Wood Slats: _____ species, square slat corners.
   1. Width: 2 inch (50 mm).
   2. Thickness: Manufacturer's s ____ inch (____ mm).
   3. Pre-finished, color as selected by Architect.

E. Slat Support: Polymer cord, ladder configuration.

F. 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.
   1. Height: As required.
   2. Color: Match slats.

G. Bottom Rail: Pre-finished, formed steel; with end caps.
   1. Color: Match headrail.

H. Control Wand: Extruded hollow plastic; hexagonal shape.
   1. Non-removable type.
   2. Length of window opening height less 3 inch (76 mm).
   3. Color: Clear.

I. Headrail Attachment: Wall brackets.

J. Accessory Hardware: Type recommended by blind manufacturer.

2.3 FABRICATION

A. Determine sizes by field measurement.

B. At openings requiring multiple blind units, provide separate blind assemblies with space of 1/4 inch (6 mm) 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. Refer to Section 06 10 00 - Rough Carpentry.

3.2 INSTALLATION

A. Install blinds in accordance with manufacturer's instructions.

B. Secure in place with flush countersunk fasteners.

C. Place intermediate head supports at spacing recommended by the manufacturer.

3.3 TOLERANCES

A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch (6 mm).

B. Maximum Offset From Level: 1/8 inch (3 mm).

3.4 ADJUSTING

A. Adjust blinds for smooth operation.

3.5 CLEANING

A. Clean blind surfaces just prior to occupancy.

B. Refer to Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

END OF SECTION 12 21 13

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SECTION 12 22 00 - CURTAINS AND DRAPES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Draperies.
   2. Formed steel track.
   3. Extruded aluminum track.
   4. Nylon carriers, cords, and accessories.

B. Related Sections:
   1. Division 26 - Electrical: Wiring from control station to operator.

1.3 REFERENCE STANDARDS

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate location and installation of concealed blocking for support of tracks.

1.5 SUBMITTALS

A. Refer to Section01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide track profiles, shapes, acceptable load data, finishes available, electrical characteristics and connection requirements, and _____.

C. Shop Drawings: Indicate end track location, width of window opening, location of blocking for anchors, appurtenances and interferences, adjacent construction, operating hardware, and support bracket details.

D. Manufacturer's Installation Instructions: Indicate procedures, perimeter conditions requiring attention, and _____.

E. Maintenance Data: Include data for motor, shaft and gearing, lubrication frequency, control adjustments, spare part sources.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
   2. Extra Carriers: Quantity equal to 5 percent of those installed.
   3. Extra Control Cords/Wands: Two of each type installed.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Drapery Track:
      a. Kirsch, Inc: www.kirsch.com.
      b. SWFcontract, a division of Springs Window Fashions, LLC: www.swfcontract.com.
      c. _____.
   2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
      a. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with

Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 COMPONENTS

A. Tracks: Extruded aluminum, bi-parting operating traverse rods, regular duty channel track.

B. Track Brackets: Formed steel wall type, for recessed installation, with screws and inserts for attachment.

C. Carriers: Nylon roller 3 per foot (10 per m).

D. Cord: Braided nylon; continuous loop, free end weighted, complying with WCMA A100.1.

E. Control Wand: Extruded hollow plastic; square shape; non-removable type; length of window opening height less 3 inches (75 mm).

F. Track Enclosure: Pre-finished, formed aluminum box; internally fitted with hardware for operation.

G. Tension Pulley: Nylon rollers in metal retainer, fixed with spring loaded tension wall bracket.

2.3 FINISHES

A. Exposed Surfaces: Baked enamel, white.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that concealed anchors are in correct position.

B. Verify that electrical service is correctly located and of proper characteristics.

3.2 INSTALLATION

A. Install drapery tracks in accordance with manufacturer's instructions.

B. Extend track 12 inches (300 mm) both sides with window trim for single track; 18 inches (450 mm) for double track where exposed.

C. Mount track and motor support brackets on solid backing. Where mounting location does not align with solid backing, provide expanding anchors for each screw hole location.

D. Anchor tension pulley to wall.

E. Set cord pulls so that cord pull is 12 inches (300 mm) below window sill in full open position.

3.3 ADJUSTING

A. Adjust drapery hardware for smooth operation.

END OF SECTION 12 22 00

SECTION 12 24 00 - WINDOW SHADES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Interior manual roller shades.
   2. Interior motorized roller shades.
   3. Accessories as required vor complete installation.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
   2. Section 26 27 26 - Wiring Devices: Finish requirements for wall controls specified in this section.

1.3 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

B. C2C (DIR) - C2C Certified Products Registry; Cradle to Cradle Products Innovation Institute; Current Edition.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

E. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

G. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
   2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.

C. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

1. Motorized Shades: Include power requirements and standard wiring diagrams for specified products.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb, and sill details, mounting dimension requirements for each product and condition, and operation direction.
   1. Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.

E. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

F. Selection Samples: Include fabric samples in full range of available colors and patterns.
   1. Motorized Shades: Include finish selections for controls.

G. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.

H. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

I. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

J. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

K. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

L. Maintenance contracts.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum 5 years of documented experience with shading systems of similar size and type.
   1. Manufacturer's authorized representative.
   2. Factory training and demonstrated experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.8 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: One year.
   2. Electric Motors: One year.
   3. Fabric: One year.

4. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Interior Manually Operated Roller Shades:
      a. Draper, Inc: www.draperinc.com.
      b. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
      c. Levolor: www.levolor.com/commercial.
      d. Lutron Electronics Co., Inc: www.lutron.com.
      e. MechoShade Systems LLC: www.mechoshade.com.
      f. Rollease Acmeda Contract: www.rolleaseacmedacontract.com.
      g. TimberBlindMetroShade: www.timberblinds.com/commercial-division.
      h. SWFcontract, a division of Springs Window Fashions, LLC.: www.swfcontract.com.
   2. Interior Motorized Roller Shades, Motors and Motor Controls:
      a. Draper, Inc: www.draperinc.com.
      b. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
      c. Levolor: www.levolor.com/commercial.
      d. Lutron Electronics Co., Inc: www.lutron.com.
      e. MechoShade Systems LLC: www.mechoshade.com.
      f. Rollease Acmeda Contract: www.rolleaseacmedacontract.com.
      g. TimberBlindMetroShade: www.timberblinds.com/commercial-division.
      h. SWFcontract, a division of Springs Window Fashions, LLC.: www.swfcontract.com.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.2 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.
   3. Motorized Shades: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed or recognized to UL 325.
      a. Comply with NFPA 70.
      b. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Where applicable, system components to be FCC compliant.
      c. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view; fully compatible with controls to be installed.

B. Interior Shades:
   1. General Requirements:
      a. Roll Direction: Roll down, closed position is at window sill, unless noted otherwise.
      b. Mounting: As indictated on Drawings.
      c. Roller Tubes:
         1) Material: Extruded aluminum.
         2) Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.

3) Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
4) Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.

d. Drop Position: Regular roll.
e. Double-Roller Drop Position:
1) Light-Filtering Fabric: Room-side of opening.
2) Room-Darkening Fabric: Glass-side of opening.

2. Manually-Operated Shades:
a. Basis of Design:
1) Mecho/5 System manufactured by MechoShade Systems, LLC.
b. Description: Manually operated fabric window shades for light-filtering, room-darkening, or both light-filtering and room-darkening as indicated on Drawings.

3. Motor-Operated Shades:
a. Basis of Design:
1) Mecho/5 System manufactured by MechoShade Systems, LLC.
b. Description: Motor operated fabric window shades for light-filtering, room-darkening, or both light-filtering and room-darkening as indicated on Drawings.

2.3 MOTOR CONTROLS

A. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.

B. Provide all components and connections necessary to interface with other systems as indicated.

C. Digital Network Controls:
1. Intelligent Motors and Devices: Identifiable over network without separate interface.
2. Provide suitable interface modules as indicated or as required for connection to standard (nonintelligent) motors and devices.
3. Capable of reprogrammed control without requiring wiring modifications.
4. Capable of assigning shade motors to shade groups/sub-groups.
5. Capable of storing programmable open and close limits and minimum of three intermediate preset stop positions for each shade.
6. Capable of aligning adjacent shades within accuracy of plus/minus 0.25 inch (6.4 mm).
7. Provide 10 year nonvolatile power failure memory for system configuration settings.
8. Basis of Design: MechoShade Systems LLC; MechoNet: www.mechoshade.com/#sle.
a. Low-voltage network utilizes standard Category 5/6 UTP cable; maximum of 4,000 feet (1,219 m), 250 nodes.
b. Network Interface Components:
1) MechoNet Network Interface; MNI Series: Four configurable motor/EDU ports (models available for RJ45 or terminal block wiring); four configurable switch ports; one infrared (IR) remote control port; one configurable serial port for RS232/RS485 communication.
2) IQ2 Dual Splitter: Two motor/EDU ports; two switch ports.
3) IQ/MLC2 Motor Group Controller: Four ports for line-voltage standard (nonintelligent) motors (120 or 230 VAC; 600 W, 1/4 HP maximum).
4) IQ Gateway; one for each floor where controlling across multiple floors.

2.4 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.4 SYSTEM STARTUP

A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.5 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

C. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.6 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

D. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.7 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

3.8 MAINTENANCE

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide to Owner, a proposal as an alternate to the base bid, a separate renewable maintenance contract for the service and maintenance of a motorized shade system for one year from date of Substantial Completion. Include a complete description of preventive maintenance, systematic examination, adjustment, parts and labor, cleaning, and testing, with a detailed schedule.

END OF SECTION 12 24 00

SECTION 12 32 00 – MANUFACTURED CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A . Section Includes:

1. Cabinet units.
2. Countertops.
3. Hardware.
4. Factory integrated components.
5. Site integrated components.

B . Related Requirements:

1. 12 36 00 - Countertops: For countertops not specified herein.

1.2 DEFINITIONS

A . Factory Integrated Components: Materials or components specified in other sections for factory assembly within manufactured casework.

B . Site Integrated Components: Materials or components specified in other sections for site assembly within manufactured casework.

1.3 ADMINISTRATIVE REQUIREMENTS

A . Preinstallation Meeting: Convene 12 weeks before starting installation work of this section in accordance with 01 31 00 'Project Management and Coordination.'

1. Attendees: Owner's representative, Architect, Contractor, and all Subcontractors interfacing with manufactured casework.
2. Review preparation, sequencing and installation procedures of the manufactured casework to coordinate the work of this section with other impacted sections.

1.4 SUBMITTALS

A . Submit the following in accordance with section 01 ## ## [submittal procedures section].

B . Submittals must be reviewed and approved by the Contractor before sending to the Architect for review.

C . Sample: Submit two samples for verification of selected finish as scheduled upon request unless noted otherwise. All wood veneer and non-standard custom finishes must be reviewed and approved by the Architect.

1. Anodized: 3 x 6 inch (76mm x 153mm) on metal.
2. Powder Coat: 2 x 4 inch (51mm x 102mm) on metal.
3. Thermofoil: As provided by thermofoil manufacturer.

D . Product Data: Provide manufacturers standard tech sheets as applicable to the project for hardware, accessories and integrated components.

E . Pre-Manufacture Submittal: Provide the following information to the manufacturer prior to development of shop drawings.

1. Field measurements of existing construction, future construction, finished width and height of walls and associated components, as well as design team provided plans, elevations and schedules.

a. Where field measurements are not possible, hold-to and control dimensions must be coordinated and agreed upon by all parties who interface with the manufactured casework through the Shop Drawing process before manufacturing begins.

2. Casework and Countertops: Include finishes, dimensions and layouts.

3. Factory Integrated Components: Provide make, model, size, configuration, materials and any additional pertinent product data for factory assembly.

4. Site Integrated Components: Provide make, model, size, configuration and any additional pertinent product data for site installation.

F . Shop Drawings: Submit shop drawings for review prior to commencing any fabrication of the manufactured casework. Coordinate as required until scope is confirmed by all affected stakeholders. Include manufacturer provided plans, elevations, isometric drawings, connection and attachment methods, and finish schedule.

1. Prior to shop drawing submittal review the drawings for obvious drafting and detailing errors.

2. Indicate finishes, component profiles, dimensions of individual components, mounting types, hardware and accessories.

3. Indicate locations of integrated components.

G . Manufacturer's Installation Instructions: Indicate any special preparation of base building conditions, installation and attachment methods.

H . Operation and Maintenance Data: Provide maintenance data for incorporation into operation and maintenance manuals.

I . Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A . Qualifications:

1. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section, of the quality and complexity required for this project for a minimum 9 years. Show production facilities capable of meeting contract requirements for single-source responsibilities and warranty.

2. Installer Qualifications: Company specializing in performing the work of this section with minimum of 2 years of experience.

B . Source Limitations: Obtain products specified herein from a single source.

1.6 DELIVERY, STORAGE, AND HANDLING

A . Do not deliver or install manufactured casework until spaces are enclosed and weather-tight, wet work is complete and dry, work above ceilings is substantially complete, and HVAC system is operational and able to maintain ambient temperature and humidity conditions between 60 and 90 degrees Fahrenheit (15.5 and 32.2 Celsius) with Relative Humidity maintained between 25 and 60 percent.

B . Do not allow packaging to get wet or develop condensation.

C . Store in a clean, dry, secure area to protect from damage. Minimize or eliminate storage prior to install by coordinating delivery with construction schedule.

D . Comply with the manufacturer's requirements for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.7 WARRANTY

A . Manufacturer Warranty: Provide 10 year warranty on manufactured casework for failures in materials or workmanship as indicated by the manufacturer standard warranty.

B . Integrated LED Warranty by component manufacturer: Provide 10 year warranty for failures in materials or workmanship as indicated by the manufacturer standard warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A . Specification is based on products listed below by DIRTT Environmental Solutions.

2.2 DESCRIPTION

A . Custom designed, frameless casework and countertops made of manufacturers standard core materials and factory applied finishes including associated accessories, hardware and integrated components.

2.3 PERFORMANCE AND DESIGN CRITERIA

A . Provide manufactured casework that is factory finished on all surfaces.

B . Provide cabinet units including base cabinets capable of being wall hung to provide a clear open space between the bottom of the cabinet unit and the finished floor.

2.4 CABINET UNITS

A . Configurations and Dimensions: As indicated on Drawings.

B . Cabinet Sides, Door and Drawer Fronts: Thickness 3/4 inch (19 mm).

1. Core Material: No Added Formaldehyde Medium Density Fiberboard Core (NAF MDF).

C . Drawer Bodies: Thickness 5/8 inch (16 mm).

1. Core Material: No Added Formaldehyde Particle Core.

2. Low profile drawer features:
    a. Manufacturers standard metal sides painted [white] [black].

D . Edges: Unless noted otherwise, Self-Edge to match specified finish with minimal visible seaming.

E . Finish Materials: Manufacturer shall provide the following standard options. See Finish Schedule below for additional information.

1. Thermofoil (THRM-1): 3D laminate film vacuum formed to substrate.

F . Interior and non-visible finishes: Type based upon exterior visible finish.

1. Manufacturer's standard Low Pressure Laminate (LPL) at Thermofoil panels.
    a. Color: White
2. Drawers: Manufacturer's standard LPL.
    a. Color: White

G . Toe Kick: Manufacturer standard un-finished plywood base frame with integrated leveling hardware for floor mounted base cabinet units.

1. Material: Manufacturer standard plywood.
2. Thickness: 3/4 inch (19 mm).
3. Height: As indicated on drawings.
    a. Minimum: 2-1/2 inch (64mm).
    b. Maximum: 9 inch (229mm).
4. Finish: [Raw/Unfinished] [Mechanically fastened MDF with finish indicated on drawings]

2.5 COUNTERTOPS

A . Finish Materials: Manufacturer shall provide the following standard options. See Finish Schedule below for additional information.

B . Thermofoil (THRM-#): 3D laminate film vacuum formed and bonded to substrate.

1. Core Material: Medium Density Fiberboard Core (MDF).
2. Thickness: [1 inch (25mm)] [1-1/4 inch (32mm)].
3. Edges: Unless noted otherwise, Self-Edge to match specified finish with minimal visible seaming.
4. Back and End Splashes: Same construction and finish material.
    a. Profile: Square top.
    b. Height: Minimum 4 inch (102mm).
    c. Thickness: 3/4 inch (19mm).
5. Interior and non-visible finishes: Manufacturer's standard wood fiber veneer unless otherwise indicated on Shop Drawings.
    a. Color: Brown

C . Solid Surface: Solid surfacing sheet or plastic resin casting over continuous substrate.

1. Performance Criteria: Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA-2 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
2. Flat Sheet Thickness: Per manufacturer's recommendation for spans indicated.
3. Edges: **<<Built up to minimum 1-1/2 inch thick; _____ edge>>**
4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
5. Interior and non-visible finishes: Manufacturer standard flat white paint.
6. Solid Surface (CRN-#): **<<Insert Project Specific Solid Surface Info>>**

NOTE TO SPEC WRITER: Hardware below is not a complete list. Hardware to be specified based upon availability from manufacturer. **(DELETE THIS TEXT)**

2.6 HARDWARE

A . General: All manufactured casework hardware located as indicated by shop drawings.

B . Door Hinges:

1. Type: Manufacturer standard 107 degree full overlay.
    a. Features: [Free swing] [Self closing].

C . Drawer and Door Pulls:

1. Rod Pull: Manufacturer standard
    a. Length: 6-1/8 inch (156mm), 6-15/16 inch (176mm), 8-3/16 inch (208mm), 10-11/16 inch (272mm)
    b. Finish: Brushed Nickle

D . Drawer Slides:

1. Type: Slide for LPL Drawer Box.
    a. Manufacturer and Model #: Tandem 560H
    b. Weight Capacity: Rated for 66 lbs (30kg).
    c. Features:
        1 Undermount.
        2 Full extension.
        3 Self-close, stay closed.
    d. Finish: Zinc
2. Type: Slide for low profile drawer box.
    a. Manufacturer standard formed metal rail.
    b. Weight Capacity: Rated for 100 lbs (45.36kg).
    c. Features:
        1 Undermount.

2 Full extension.

3 Self-close, stay closed.

E . Locks:

1. Type: Keyed
   a. Manufacturer Standard
2. Type: Keyless
   a. Manufacturer and Part #: StealthLock SL-100
   b. Features: Concealed, Programmable, RF Remote Controlled

2.7 ACCESSORIES

A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B . Integrated recessed LED luminaire:

1. Wiring: Manufacturer provided cable with NEMA 1-15P (non-polarized) 45° low profile plug for every 19 continuous linear feet (5.79m) of luminaire.
2. Driver/Power Supply: One 12V constant, 0-40W “Power Pack” for every 19 continuous linear feet (5.79m).
3. Color Temperature: [Warm (3000K)] [Cool (4000K)].
4. Switch Type: [Touchless Sensor] [Push Button] [Door Sensor] [Wall Switch provided in accordance with Division 26 requirements].

C . Integrated USB power: Manufacturer standard USB docking station for charging devices within drawers.

1. Number of Ports: 4
2. Finish: White
3. Dimensions: 2-1/2 inches (64mm) x 7-3/16 inches (182mm)
4. Features: Integrated switch/circuit breaker
5. Power Source: Provided in accordance with division 26 Electrical requirements.

D . File Bars: Manufacturers standard integrated aluminum flat bar hanging file rail.

1. Orientation: [Left to Right] [Front to Back]
2. Paper Size: [Letter, 8-1/2 x 11 inches (216 x 279mm)] [Legal, 8-1/2 x 14 inches (216 x 356 mm).
3. Finish: Manufacturers standard “Shimmer” color powder coat. See finish schedule below.

E . Grommet: Manufacturers standard plastic grommet for cabling.

1. Color: Black.
2. Diameter: 3 inch (76mm).

F . Waste Bin: Manufacturers standard metal container with plastic lid.

1. Finish: Manufacturers standard white

2.8 FABRICATION

A . Cabinet Units:

1. Cabinet units shall be factory assembled with concealed fasteners at panel to panel connections.
2. Cabinet units shall have no raw unfinished surfaces and all surfaces shall be factory finished.

B . Countertops:

1. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
2. Join lengths of tops using best method recommended by manufacturer.
3. Fabricate fronts and ends of cabinets with a minimum 1/2 inch overhang except where top butts against cabinet or wall.
4. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
5. Finish all visible and non-visible surfaces with manufacturer standard finishes suitable for the application of the countertop.
6. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.
7. Solid Surfacing: Fabricate up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

C . Back or Side Splash: Provide back or side splash wherever counter edge abuts vertical surface unless otherwise indicated.

1. Secure to countertop with concealed fasteners and secure finish surfaces with a waterproof glue.
2. Height: 4 inches, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A . Verify existing conditions meet the manufacturer's requirements before starting work.

B . Examine all adjoining work including work by others.

C . Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

B . Locations to receive manufactured casework shall be inspected for compliance with manufacturers requirements.

C . Field conditions and pre-existing installations by others which may adversely affect installation or exceed the manufacturers limitations shall be corrected before installing manufactured casework.

3.3 INSTALLATION

A . General: Install all materials in accordance with manufacturer's instructions based on conditions present and pre-installation meeting.

B . Install toe kicks in locations as indicated by drawings and adjust levelers in preparation of base cabinet units.

C . Install base cabinet units on top of manufacturer provided toe kicks per shop drawings.

D . Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

E . Seal joint between back or side splashes and vertical surfaces.

F . Manufacturer provided drawer pulls ship mounted to inside of cabinet unit. Installer to remove and install in final position per shop drawings.

3.4 TOLERANCES

A . Variation From Horizontal, cabinet units and countertops: 1/8 inch in 10 feet, maximum.

B . Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C . Field Joints: 1/8 inch wide, maximum

3.5 ADJUSTING

A . Adjust and lubricate hardware for proper operation in accordance with manufacturer’s instructions.

3.6 CLEANING

A . Dispose of all waste material in accordance with Section 01 ## ## - [construction waste management section] and project's Waste Management Plan.

B . Upon completion of installation clean finishes in accordance with the manufacturer’s instructions. Avoid alkaline or abrasive agents. Avoid scratching or marring finishes.

3.7 PROTECTION

A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, warranty, and to avoid scratching or marring of finishes.

3.8 FINISH SCHEDULE

A . (ANO-1) Anodized:

1. Type: Manufacturer Standard AAMA 611, AAM12C22A31, Class I
2. Color: Clear.

B . (THRM-1) Thermofoil:

1. Type: Manufacturer Standard
2. Grade: 3
3. Color Name: Arturo Candlelight.
4. Grain Direction: Vertical
5. Notes: Uppers and Lowers.

C . (THRM-2) Thermofoil:

1. Type: Manufacturer Standard
2. Grade: 1
3. Color Name: Snow White.
4. Notes: Surfaces.

D . (CRN-1) Solid Surface:

1. Finish:
2. Notes: Sufaces.

END OF SECTION

SECTION 12 36 00 - COUNTERTOPS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Countertops for architectural cabinet work.
   2. Countertops for manufactured casework.

B. Related Sections:
   1. Section 11 53 13 - Laboratory Fume Hoods: Work surfaces inside fume hoods.
   2. Section 12 35 53.19 - Wood Laboratory Casework: Laboratory countertops.
   3. Section 22 40 00 - Plumbing Fixtures: Sinks.

1.3 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

D. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.

E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

G. AWI (QCP) - Quality Certification Program; Current Edition.

H. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

I. AWMAC (GIS) - Guarantee and Inspection Services Program; Current Edition.

J. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

K. IAPMO Z124 - Plastic Plumbing Fixtures; 2022.

L. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

M. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.

N. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

O. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

P. NSF 51 - Food Equipment Materials; 2023.

Q. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.

R. PS 1 - Structural Plywood; 2023.

S. SEFA 2 - Installations; 2010.

T. SEFA 3 - Laboratory Work Surfaces; 2020.

U. WI (CCP) - Certified Compliance Program (CCP); Current Edition.

V. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.

W. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.4 PERFORMANCE REQUIREMENTS

A. Countertops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:
   1. All deadloads.
   2. 500 pound live load placed on the countertop and vanity.
   3. Deflection at Midspan: L/1000 times span or 1/8 inch (3 mm) whichever is less.

B. WI Premium Grade: Where indicated on Drawings.

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

H. Installer's qualification statement.

I. Installation Instructions: Manufacturer's installation instructions and recommendations.

J. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

B. Quality Certification:
   1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
      a. This AWI (QCP) project is registered as project number _____.
   2. Comply with AWMAC (GIS) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
   3. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.woodworkinstitute.com.
   4. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   5. Provide designated labels on shop drawings as required by certification program.
   6. Provide designated labels on installed products as required by certification program.
   7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

A. Warranty the work specified herein for 5 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include but not be limited to the following:
   1. Rough or difficult operation, or loose or missing parts.
   2. Delamination of surfaces.
   3. Noticeable deterioration of finish.
   4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
   1. Manufacturers listed for products in this Section.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
   1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 COUNTERTOPS

A. General:
   1. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   2. Quality Standard: SEFA 3 for laboratory worksurfaces.

B. Solid Surfacing Countertops and Window Sills: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Basis of Design Product:
         1) Products manufactured by Wilsonart.
      b. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
      c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      d. NSF approved for food contact.
      e. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
      f. Color and Pattern:
         1) STC1: Avalanche Melange 9175ML.
         2) STC2: Frosty White, 1573SL
   2. Other Components Thickness: 1/2 inch (12 mm), minimum.

3. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
4. Skirts: As indicated on Drawings.
5. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
6. Fabricate in accordance with manufacturer's standard requirements.

2.3 MATERIALS

A. Wood-Based Components:
1. Wood fabricated from old growth timber is not permitted.
2. Provide sustainably harvested wood, certified or labeled; refer to Section 01 60 00 - Product Requirements.
3. Provide wood harvested within a 500 mile (805 km) radius of the project site.
4. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.

B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.

C. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.

D. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.

E. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

F. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch (12 mm) by 1/2 inch (12 mm).
1. Color: As indicated on drawings.
2. Color: As selected by the Architect from manufacturer's full line.

G. Joint Sealant: Mildew-resistant silicone sealant, white.

H. Polyester Protective Film: Scratch-, heat-, and acid-resistant optically clear removable polyester film for bonding to stone counters.
1. Thickness: 4 mil, 0.004 inch (0.1 mm), minimum.
2. Finish: Gloss.
3. Construction: Multi-ply laminate.
4. Adhesive Type: Pressure sensitive acrylic.
5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
6. NSF approved for food contact per NSF 51.
7. Basis of Design Products:
   a. Products manufactured by Stoneguard USA; _____: www.stoneguardusa.com/#sle.
   b. Products manufactrued by Surface Shields, Inc.
   c. TuffSkin manufactured by TuffSkin Surface Protection LLC.
   d. Products manufactured by _____.

I. Sealer: Stain and acid protection for natural stone counters.
1. NSF approved for food contact per NSF 51.
2. Products:
   a. Products manufactrued by Custom Building Products.
   b. Natural Finish Stone Sealer manufactured by Rockstar Sealing.
   c. Products manufactured by STONETECH.
   d. Products manufactured by _____.

2.4 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
      a. Rout a 1/8 inch (3 mm) drip groove at underside of exposed overlapping edges, set back 1/2 inch (13 mm) from face of edge.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash where indicated on Drawings.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches (102 mm), unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install vanities in accordance with manufacturer’s instructions and approved shop drawings

B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

C. Seal joint between back/end splashes and vertical surfaces.
   1. Where indicated use rubber cove molding.
   2. Where applied cove molding is not indicated use specified sealant.

3.4 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.

B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.

C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.5 CLEANING

A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 12 36 00

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SECTION 13 17 23 - THERAPEUTIC POOLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.

1.2 SUMMARY

A. Section includes:
   1. Therapeutic Pools.
   2. Accessories as required for a complete installation.

B. Related Sections
   1. Division 22 - Plumbing.
   2. Division 26 - Electrical.

1.3 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Warranty.

C. Verification Samples: For each finish product specified, minimum size 6 inches (305 mm) square, representing actual product in color and texture.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Package for protection against transportation damage.
   2. Provide markings to identify components consistently with drawings.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well-ventilated space out of direct sunlight.
   2. Protect from moisture and condensation.
   3. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.5 WARRANTY

A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Specifications are based on the products identified as Basis of Design. Listed manufacturers who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent to those specified and comply with Division 01 requirements regarding substitutions to be considered.
   1. ColdTub.
   2. Hydroworx.
   3. SwimEx, Inc.
   4. Whitehall Whirpool.

B. Substititions: Refer to Section 01 25 13 - Product Substitution Procedures.

C. Basis of Design: "The Icebox" manufactured by ColdTub.

D. Sizes:
   1. Small: 76.5 inches by 76.5 inches by 30 inches.
   2. Large: 108 inches by 76.5 inches by 30 inches.

2.2 PRODUCTS

A. Theraputic Pool (THP): Type 1.
   1. Basis of Design: SB-100 as manufactured by Whitehall.
   2. Size: 76 inches L by 40 inches W by 24 inches D.
   3. Material: Stainless Steel.
   4. FinishL Polished Satin.
   5. Tank Capacity: 100 Gallons.

B. Theraputic Pool (THP): Type 2.
   1. Basis of Design: Lo-Boy as manufactured by Whitehall.
   2. Size: 66 inches L by 24 inches W by 18 inches D.
   3. Material: Stainless Steel.
   4. Finish: Polished Satin.
   5. Tank Capacity: 105 Gallons.

C. Theraputic Pool (THP): Type 3.
   1. Basis of Design: Extremity E-22 Series as manufactured by Whitehall.
   2. Type: Mobile Whirlpool.
   3. Size: 28 inches L by 15 inches W by 18 inches D.
   4. Material: Stainless Steel.
   5. Finish: Polished Satin.
   6. Tank Capacity: 22 Gallons.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and conditions affecting performance of work. Coordinate installation of equipment, appliances, fixtures, and other items.
   1. Examine roughing in for piping systems and verify actual locations of piping connections before equipment installation.
   2. Examine electrical circuits and rating and verify locations and sufficient ratings for items requiring electrical power.
   3. Examine space to receive items and verify the space is of sufficient size and configuration for items.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions. Install fixtures level and plumb according to roughing in drawings.

B. Power Supply: Coordinate power supply, grounding, outlets, and electrical wiring with locations indicated for appliances and equipment.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities: Refer to plumbing and electrical sections for plumbing and electrical requirements.

E. Connections and Hook ups: Coordinate location of services.
   1. Grounding: Ground equipment in accordance with applicable standards and code requirements.
   2. Wiring: Connect wiring in accordance with manufacturer recommendations.

3. Provide necessary electrical outlets.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory authorized service representative:
   1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturer written recommendations. Certify compliance with each manufacturer appliance performance parameters.
   2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After installation, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Test each equipment item to verify proper operation. Make necessary adjustments. Replace malfunctioning appliances and components, then retest. Repeat procedure until units operate properly.

3.4 CLEANING

A. Clean equipment with manufacturers' recommended cleaning methods and materials. After completing installation of equipment and fixtures, inspect exposed finishes and repair damaged finishes. Remove packing materials from site.

3.5 PROTECTION

A. Provide protective covering for installed equipment. Do not allow use of equipment items for temporary facilities.

3.6 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 13 17 23

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SECTION 13 42 75 – INTEGRATED INTERIOR ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A . Section Includes:

1. Assembly framing.
2. Finish panels.
3. Doors and frames.
4. Door hardware.
5. Electrical.
6. Communications.
7. Mechanical/Plumbing Accommodation.
8. Factory integrated components.
9. Site integrated components.

B . Related Requirements:

1. 08 10 00 - Doors and Frames for site integrated components.
2. 08 71 00 - Door Hardware for site integrated components.
3. Division 26 - Electrical for site integrated components and commissioning.
4. Division 27 - Communications for site integrated horizontal cabling.
5. Division 28 - Electronic Safety and Security for site integrated components.

1.2 DEFINITIONS

A . Finish Panel: Site installed panels with factory applied final finish and cutouts for accommodation of mechanical, electrical and plumbing components.

B . Conventional back box: Standard NEC device metallic back box.

C . Specialty back box: Proprietary back box required for devices other than those specified in this section.

D . Site Integrated Components: Materials or components specified in other sections for site assembly within integrated interior assemblies.

1.3 ADMINISTRATIVE REQUIREMENTS

A . Preinstallation Meeting: Convene 8 weeks before starting installation work of this section in accordance with 01 31 00 ‘Project Management and Coordination.’

1. Attendees: Owner’s representative, Architect, Contractor, and all Subcontractors interfacing with integrated interior assemblies.
2. Review preparation, sequencing and installation procedures of the integrated interior assemblies to coordinate the work of this section with other impacted sections.

1.4 SUBMITTALS

A . Submit the following in accordance with section 01 33 00 'Submittal Procedures'

B . Submittals must be reviewed and approved by the Contractor before sending to the Architect for review.

C . Sample: Submit two samples for verification of selected finish as scheduled upon request unless noted otherwise. All wood veneer and non-standard custom finishes must be reviewed and approved by the Architect.

1. Anodized: 3 x 6 inch (76mm x 153mm) on metal.
2. Chroma coat:
    a. Standard Color: 2 x 2 inch (51mm x 51mm) paint chip.
    b. Custom Color: 4 x 6 (102mm x 153mm) inch on MDF.
3. Powder Coat: 2 x 4 inch (51mm x 102mm) on metal.
4. Fabric: As provided by textile manufacturer.
5. Glass: 4 x 4 inch (102mm x 102mm).
6. Magnetic Markerboard: 4 x 4 inch (102mm x 102mm) on MDF.
7. Thermofoil: As provided by thermofoil manufacturer.
8. WriteAway Laminate: [4 x 8 inch (102mm x 203mm)] [8 x 10 inch (203mm x 254mm)].
9. Custom Graphics: As provided by manufacturer based on finish type.

D . Product Data: Provide manufacturers standard tech sheets as applicable to the project for the following: Assembly framing, Finish Panels, Doors and Frames, Door Hardware, Electrical, Communications, Mechanical/Plumbing Accommodation and Accessories.

E . Pre-Manufacture Submittals: Provide the following information to the manufacturer prior to development of shop drawings.

1. Field measurements of existing construction, future construction, finished width and height of walls and associated components, as well as design team provided plans and elevations.
    a. Where field measurements are not possible, hold-to and control dimensions must be coordinated and agreed upon by all parties who interface with the integrated interior assemblies through the Shop Drawing process before manufacturing begins.
2. Wall hung items: Include make, model, size, configuration and any additional pertinent product data for wall hung items such as furniture, fixtures, equipment and casework.
3. Assembly framing: Include selected wall types.
4. Finish Panels: Include finishes and configurations.
5. Doors and Frames: Include cores, finishes, frames, and operations.
6. Door Hardware: Include manufacturers standard hardware and site integrated component hardware.
    a. One sample of each type of Site Integrated Door Hardware that is to be installed in doors included in this section shall be sent to manufacturer for review and approval.

7. Electrical: Include device type and location, schedules indicating electrical device specifications, amperage, ground pin orientation, type of solution, wiring configuration, receptacle, faceplate and trim ring colors and styles, and any Factory or Site Integrated Components.
8. Communications: Include device type and location, schedules indicating communications device specifications, type of solution, cabling configuration, faceplate and data jack colors and styles and any Factory or Site Integrated components.
9. Mechanical/Plumbing Accommodation: Include product data, fabrication drawings and schematics for any Factory or Site Integrated Components.
10. Factory Integrated Components: Provide make, model, size, configuration, materials and any additional pertinent product data for factory assembly.
11. Site Integrated Components: Provide make, model, size, configuration and any additional pertinent product data for site installation.

F . Shop Drawings: Submit shop drawings for review prior to commencing any fabrication of the integrated interior assemblies. Coordinate as required until scope is confirmed by all affected stakeholders. Include manufacturer provided plans, elevations, sections, schedules and applicable notes per the following:

1. Prior to shop drawing submittal review the drawings for obvious drafting and detailing errors.
2. Indicate material descriptions, dimensions and profiles of adjacent components and assemblies interfacing with the integrated interior assemblies.
3. Indicate field measurements of existing construction, future construction, finished width and height of assemblies and associated components.
4. Assembly framing: Indicate reveal type, profile type, finishes and attachment to base building.
5. Finish Panels: Indicate finishes, cores, glazing, accessories and configurations.
6. Doors, Frames and Hardware: Include elevations indicating glazing and finishes, schedules indicating door tags, styles, dimensions, handing, hardware and finishes.
7. Electrical:
    a. Coordinate electrical components specified herein with the documents provided by the electrical engineer of record.
    b. Indicate types and locations of wiring devices, outlet, junction and pull boxes, copper conductors and cables, conduit, electrical branch circuiting, amperage, ground pin orientation, wiring diagrams, and faceplate, receptacle and trim ring colors and styles.
8. Mechanical/Plumbing Accommodation: Indicate location of chase, mounting brackets and blocking, and provisions for fixture carriers.
9. Communications: Indicate device type and location of components within the integrated interior assembly. See division 27 for additional submittal requirements.
10. Factory and Site Integrated Components: Indicate device type and location.

G . Manufacturer's Installation Instructions: Indicate any special preparation of base building conditions, installation and attachment methods.

H . Operation and Maintenance Data: Provide maintenance data for incorporation into operation and maintenance manuals.

I . Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

J . Closeout Submittals: Submit copy of packing slip for shipment of re-usable packaging "cookies" and modular electrical dust caps back to manufacturer.

K . Installer Performed Testing: Submit documentation of installer performed tests and certification for submission to the Authority Having Jurisdiction.

1.5 QUALITY ASSURANCE

A . Qualifications:

1. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section, of the quality and complexity required for this project for a minimum 10 years. Show production facilities capable of meeting contract requirements for single-source responsibilities and warranty.
2. Delegated Designer Qualifications: Professional structural engineer with 3 years of documented experience in design of this work and licensed in the location of the project.
3. Wall Installer Qualifications: Company trained and certified by manufacturer and specializing in performing the work of this section.
4. Integrated Electrical Components Installer Qualifications: Connections to the base building electrical system and all field installed electrical components, devices, and accessories require installation by an electrical contractor licensed in the jurisdiction of the project in accordance with applicable building and electrical codes and standards. Such work shall be performed under permit, tested, and inspected to confirm adequacy of final installations to the satisfaction of the Authority Having Jurisdiction.

B . Source Limitations: Obtain integrated interior assemblies from a single source.

1.6 DELIVERY, STORAGE, AND HANDLING

A . Do not deliver or install integrated interior assemblies until spaces are enclosed and weather-tight, wet work is complete and dry, work above ceilings is substantially complete, and HVAC system is operational and able to maintain ambient temperature and humidity conditions between 60 and 90 degrees Fahrenheit (15.5 and 32.2 Celsius) with Relative Humidity maintained between 25 and 60 percent.

B . Do not allow packaging to get wet or develop condensation.

C . Comply with the manufacturer’s requirements for a warrantable installation of the installed products to meet the Performance and Design Criteria.

D . Collect and return re-usable packaging "cookies" and modular electrical dust caps to manufacturer.

1.7 WARRANTY

A . Manufacturer Warranty: Provide 10 year warranty on walls, doors, door frames, electrical, communications and Mechanical/plumbing accommodations for failures in materials or workmanship as indicated by the manufacturer standard warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A . Specification is based on products listed below by DIRTT Environmental Solutions.

2.2 DESCRIPTION

A . Factory assembled, site installed, integrated interior assemblies, including Assembly framing, Finish Panels, Doors and Frames, Door Hardware, Electrical, Communications, Mechanical/Plumbing Accommodation, and Factory and Site Integrated components.

2.3 PERFORMANCE AND DESIGN CRITERIA

A . Provide integrated interior assemblies that are factory sub-assembled, and site installed to integrate with the base building structure, shell, mechanical, electrical and plumbing systems.

B . Integrated Interior Assembies shall be non-progressive in method of installation so that frame modules within an elevation can be removed, added or changed without affecting adjacent frame modules.

C . Walls shall utilize factory finish site installed panels that mechanically fasten to a factory finished and assembled aluminum structural frame module. Finish panels may be monolithic or segmented with the ability to span off-module, or across multiple frames in segments or monoliths, vertically and horizontally.

D . Assembly shall allow for independent configuration of assembly framing, finishes and functions relative to each side of the wall.

E . Assembly shall be comprised of components which can be disassembled, relocated and field cut and substantially reused for future reconfigurations allowing for adaptability and retrofitting of the Assembly framing, Finish panels, Doors and Frames, Door Hardware, Electrical, Communications, Mechanical/Plumbing Accommodation, and Factory and Site Integrated components.

F . Assembly framing shall be capable of supporting wall hung accessories including but not limited to: casework, furniture, systems furniture, shelves, countertops and equipment in channels or reveals that are integrated within the structural frame and enable universal horizontal alignment without damaging finishes.

G . Integrated interior assembly shall provide accommodation or provision for the embedding (fully encased behind glass) of electronics in the wall cavity. Structural framing shall allow for universal non-standard AV display, sound, and various support equipment to be mounted in the cavity of the wall with all required structural brackets, wire management, access and ventilation equipment to prevent overheating.

H . Integrated interior assembly shall enable access of the internal cavity from either side without the addition of an access panel or need for repairing of finishes.

I . Provide integrated interior assembly with a continuous open cavity vertically and horizontally free of structural impediments for the routing of mechanical, electrical and plumbing components.

J . Provide integrated interior assemblies capable of accommodating up to a 1-inch (25 mm) gap between the top, bottom and side edges of the prefabricated assembly and base building elements.

K . Provide an integrated interior assembly system capable of accepting pressure fit extrusions and co-extrusions to fill voids between finish panels, at ceiling connections, and other base building connections.

L . The manufacturer of finish panels specified herein shall be capable of incorporating owner provided factory finished custom graphics on finish panels.

M . Structural Performance:

1. Capable of withstanding the effects of loads and stresses within limits allowable by the local authority having jurisdiction and under conditions indicated:

    a. Transverse Load: Lateral deflection of the overall span when tested under a uniformly distributed load of 5 psf (0.24 kN/m2) in accordance with ASTM E72 where (L) equals wall height:

        1. Solid Walls: not more than L/120

        2. Glass Walls: not more than L/175 or 3/4 inch (19 mm) whichever is more stringent.

    b. Where glass panels are installed adjacent to a walking surface, the differential deflection of two adjacent unsupported edges of glass shall not be greater than the thickness of glass when a force of 50 pounds per linear foot (plf) (730 N/m) is applied horizontally to one panel at any point up to 42 inches (1067 mm) above the walking surface.

N . Acoustic Attenuation:

1. Sound Transmission Class (STC) rating of integrated interior assemblies shall be calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2. Interior Walls Indicated as Acoustic: Provide completed assemblies with the following characteristics:

    a. Four inch (102mm) solid wall: 40-45 STC.

    b. Six inch (152mm) solid wall: 45-50 STC.

    c. Four inch (102mm) single glazed wall: 30-35 STC.

O . Fire Resistance:

1. Surface-Burning Characteristics:

    a. Finish materials shall be tested in accordance with ASTM E84 or NFPA 286.

2. Integrated Interior Assembly shall be approved for use by a qualified independent testing agency in Type I and Type II Construction.

P . Assembly UL Ratings:

1. UL QQXX ; Sections and Units per 2017 NFPA 70 National Electrical code.

2. UL QQYZ; Wiring Assemblies.

3. UL 183; Standard for Safety for Manufactured Wiring Systems.

4. UL 498; Standard for Safety for Attachment Plugs and Receptacles.
5. UL 507; Component Fans, Electric.
6. UL 514A; Standard for Safety for Metallic Outlet Boxes.
7. UL 514 B; Standard for Conduit Cable and Fittings.
8. UL 514C; Standard for Safety for Non; Metallic Outlet Boxes, Flush; Device Boxes, and Covers.
9. UL 514D; Standard for Safety for Cover Plates for Flush; Mounted Wiring Devices.
10. UL 723; Standard for Test for Surface Burning Characteristics of Building Materials
11. UL 1784; Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives.

2.4 ASSEMBLY FRAMING

A . One sided wall framing: Fully assembled non-bearing structural frame module with site installed finish panels on one side.

1. Wall Thickness: Actual 2.125 inch (54mm) or 3.8 inch (96mm) or 5.8 inch (147mm) in locations indicated by drawings.
2. Reveal Type and Size: Classic 0.354 inches (9 mm)
3. Material: Aluminum extrusions, 6063-T6 aluminum alloy classified as noncombustible in accordance with ASTM E136 per 2018 IBC 703.5.1.
    a. Thickness: As required to meet performance requirements.
4. Top Track: Continuous, with intermittent breaks for pass through of building services or structural components.
5. Bracing: as required to meet structural performance requirements.
6. Bottom Track: Integral with modular frames.
    a. Provide frame bases with continuous adjustment mechanism for 1-1/2 inch (38mm) height adjustment to accommodate floor slab variances.
    b. Accessories: non-seismic carpet grippers, non-seismic smooth floor tape and seismic floor anchor attachment where required.
7. Vertical Element Spacing: As required to meet performance requirements within a minimum of 6 inches (152mm) and a maximum of 48 inches (1219mm).
8. Blocking Bracket: Adjustable factory mounted 4 inch (102mm) or 6 inch (152mm) concealed structural blocking fabricated of 12 gauge or 16 gauge galvanized steel in a horizontal or vertical orientation between aluminum extrusions for wall mounted components.
9. Provide cutouts and support brackets as required for plumbing, electrical and communication pass through from frame to frame.
10. Insulation: manufacturers standard non-woven, unfaced recycled denim batt insulation containing cotton fibers and proprietary materials with a flame spread index of 25 or less and smoke developed index of 450 or less when tested in accordance with ASTM E84 and has been evaluated for corrosiveness, fungi-resistance, and moisture absorption by testing in accordance with ASTM C739.

B . Two sided wall framing: Fully assembled non-bearing structural frame module with site installed finish panels on both sides.

1. Wall Thickness: Actual 4 inch (102mm) or 6 inch 152mm) or 6 to 12 inch (152mm to 305mm) parametric expandable wall in locations indicated by drawings.
2. Reveal Type and Size: [Classic 0.354 inches (9 mm)] [Enzo 0.157 inches (4 mm)] [Enzo Coplanar 0.157 inches (4 mm)]
3. Material: Aluminum extrusions, 6063-T6 aluminum alloy classified as noncombustible in accordance with ASTM E136 per 2018 IBC 703.5.1.
    a. Thickness: As required to meet performance requirements.
4. Top Track: Continuous, with intermittent breaks for pass through of building services or structural components.
5. Bracing: as required to meet structural performance requirements
6. Bottom Track: Integral with modular frames.
    a. Provide frame bases with continuous adjustment mechanism for 1-1/2 inch (38mm) height adjustment to accommodate floor slab variances.
7. Accessories: non-seismic carpet grippers, non-seismic smooth floor tape or seismic floor anchor attachment].
8. Vertical Element Spacing: As required to meet performance requirements within a minimum of 6 inches (152mm) and a maximum of 48 inches (1219mm).
9. Blocking Bracket: Adjustable factory mounted 4 inch (102mm) and 6 inch (152mm) concealed structural blocking fabricated of 12 gauge or 16 gauge galvanized steel in a horizontal or vertical orientation between aluminum extrusions for wall mounted components.
10. Provide cutouts and support brackets as required for plumbing, electrical and communication pass through from frame to frame.
11. Insulation: manufacturers standard non-woven, unfaced recycled denim batt insulation containing cotton fibers and proprietary materials with a flame spread index of 25 or less and smoke developed index of 450 or less when tested in accordance with ASTM E84 and has been evaluated for corrosiveness, fungi-resistance, and moisture absorption by testing in accordance with ASTM C739.

C . Glazed wall framing: Site assembled non-bearing structural frame module with glass infill.

1. Wall Thickness: Actual 4 inch (102mm).
2. Extrusion Profile: Rectilinear
3. Reveal Type and Size: Classic 0.354 inches (9 mm)
4. Material: Aluminum extrusions, 6063-T6 aluminum alloy classified as noncombustible in accordance with ASTM E136 per 2018 IBC 703.5.1.
    a. Thickness: As required to meet performance requirements.
5. Top Track: Continuous, with intermittent breaks for structural components.
6. Bracing: as required to meet structural performance requirements
7. Bottom Track: Integral with modular frames.
    a. Provide frame bases with continuous adjustment mechanism for 1-1/2 inch (38mm) height adjustment to accommodate floor slab variances.
    b. Accessories: non-seismic carpet grippers, non-seismic smooth floor tape or seismic floor anchor attachment where required.

8. Vertical Element Spacing: As required to meet performance requirements within a minimum of 6 inches (152mm) and a maximum of 60 inches (1524mm).
    a. Vertical Element spacing may exceed 60 inches (1524mm) with manufacturer review and approval.
9. Glazing Finish Panel: Per Schedule Below.
10. Glazing Gasket Color: black or silver.

D . Assembly framing Exposed Finishes:
1. Clear Anodized Aluminum: AAMA 611, AAM12C22A31, Class I
2. Powder coat:
    a. Finish: Per Finish Schedule below.

2.5 FINISH PANELS

A . Factory Finished Panel: Finish panels shall meet the finish classification requirement per International Building code for the proposed location in the building.
1. Core Material: Medium Density Fiberboard Core (MDF).
    a. Features:
        1. Flame Retardant (FR MDF) and TSCA Title VI compliant
2. Finish Material: Manufacturer standard options shall be classified in accordance with ASTM E84. See Finish Schedule below for additional information.
    a. ChromacoatPlus: Manufacturers standard no Volatile Organic Compounds (VOC) water-based paint sprayed onto substrate with cleanable clear topcoat.
        1. Maximum Size: 60 x 120 inches (1524mm x 3048mm).
        2. Finish Classification: Class A with FR MDF core.
    b. Thermofoil: 3D laminate film vacuum formed to substrate.
        1. Maximum Size: 48 x 120 inches (1219mm x 3048mm).
        2. Finish Classification: Class A with FR MDF core.
    c. WriteAway: Dry Erase 3D laminate film vacuum formed to substrate.
        1. Maximum Size: 46 x 120 inches (1168mm x 3048mm).
        2. Features: Magnetic with Matte Finish, High Gloss Finish, or Custom Graphics
        3. Finish Classification: Class A with FR MDF core.
3. Mounting: Face Mounted.
4. Thickness:
    a. Typical: 1/2 inch (13mm).
    b. With integral base: 3/8 inch (9.5mm).

B . Glass Finish Panel:
1. Glazing Material:

a. Tempered glass (GLS-1): Architectural flat glass per ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type 1, Class 1 (transparent), Quality q3. Complies with CPSC-16 CFR Part 1201 Category II per IBC 2018.2406.2.

1. Features: Meets ANSI Z97.1 Safety Glazing Material standards.

2. Thickness: 1/4 inch (6mm) or 3/8 inch (10mm).

3. Finish: Per Finish Schedule below.

2. Mounting: Center Mounted for glazed walls and doors

a. Face Mounted Features:

1. Aluminum mounting rails to maintain alignment with adjacent finishes.

2. Where specified 1/4 inch (6mm) tempered glass has a maximum size of: 60 x 120 inches (1524mm x 3048mm).

2.6 DOORS AND FRAMES

A . Coordinate ADA, ANSI, Access Control and Fire Life Safety requirements with drawings and schedules prior to the development of shop drawings per Pre-Manufacture Submittal requirements.

B . Hardware Preparation and Reinforcement: Factory milled, reinforced, drilled and taped doors and frames by manufacturer to receive Integrated Hardware Components as scheduled.

1. Factory milled doors and frames with hinge locations and sizes as determined by integrated interior assembly manufacturer; including factory installed steel backer plates.

2. Access Control Components: Factory provided rough in for Site Integrated Components and integrated interior assembly manufacturer provided hardware.

C . Provide manufacturers standard UL 1784 “S” labeling on doors within smoke partitions as indicated by door schedules.

D . Coordinate door types, sizes, operations and hardware requirements specified within this section with drawings and door schedules.

E . Door Thickness is 1-11/16 inch (43mm) unless noted otherwise.

F . Aluminum Framed Glass Doors:

1. Type: “Goldie”

a. Operation: side hung swing

b. Stile and Rail Dimensions: 4 inch (102mm) side stiles, 2 inch (51mm) center stile (center pivot only), 4 inch (102mm) top rail, 6 inch (152mm) bottom rail or 10 inch (254mm) ADA bottom rail.

c. Glazing: Tempered 1/4 inch (6mm).

2. Finish:

a. Powder coat grade 2.

1. Color: Per schedule below.

3. Adjustability: Provide door skirt to accommodate varying floor levels.

4. Features: UL 1784 Smoke and draft control door assemblies with 4 inch (102mm) or 6 inch (152mm) stiles for side hung swing doors only as scheduled.

G . Solid Core Wood Doors:

1. Operation: side hung swing
2. Door Panel: Factory finished high density fiberboard faces over particleboard core.
3. Finish:
    a. Thermofoil: Manufacturers standard 3D laminate
        1. Grade: 2
        2. Color/Pattern: Per Finish Schedule below.
4. Features: UL 1784 Smoke and draft control door assemblies for side hung swing doors only as scheduled.

H . Door Frames:

1. Architectural grade structural aluminum factory finished and integrated with wall framing.
2. Door frames capable of reconfiguration without part replacement or damage to wall components.
3. Frames are shipped knocked down and assembled on site.
4. Jambs shipped over length by 2 inches (50 mm) in height, for field cutting to suit opening height for proper alignment with adjacent frames.
5. Extrusion Profile: Rectilinear.
6. Configuration: As required by door operation or function.
7. Size: As required for doors sizes indicated on Door Schedule.
8. Standard Frame Depth: 4 inches (102mm)
9. Finish:
    a. Powder coat grade 2.
        1. Color: Per Finish Schedule below.

2.7 DOOR HARDWARE

A . Site Integrated Components: Provide in accordance with Division 08 Openings and Division 28 Electronic Safety and Security.

B . All Hardware indicated in this section to be provided by the manufacturer or the manufacturers distribution partner and installed on site unless indicated otherwise.

C . General Door Hardware:

1. Hinges: Stanley 4-1/2 x 4 inch (114mm x 102mm) Butt Hinge F179. Four hinges per door; no exceptions.
2. Cylindrical Series Hardware:
    a. Schlage “S” Series Cylindrical Hardware:
        1. Lever Style: [Jupiter] [Neptune] [Saturn]

2. Model number and Function: [Refer to manufacturers' standard hardware glossary and insert model Number and Function]

b. Falcon "B" Series Cylindrical Hardware:

1. Lever Style: [Dane] [Quantum]

2. Model number and Function: [Refer to manufacturers' standard hardware glossary and insert model Number and Function]

3. Circular Bar Pull: 1 inch (25mm) diameter x 72 inches (1829mm) in height

a. Features:

1. Locking Bar Pull: Height determined by Door Height

4. Electromagnetic Lock: [Schlage M420] [Schlage 320M].

5. Floor Stops: Dome.

6. Acoustical Seals: Manufacturers Standard to accommodate door operation.

a. Type: Jamb and Header.

b. Color: Black.

7. Aluminum Framed Glass Door Gasket Color: Black.

D . Hardware Finishes: BHMA Standard finishes provided as follows unless indicated otherwise:

1. 626 - Satin Chrome: lever sets, flush bolt, dead bolt, metal roller catch, bolt, strike plate, dome floor stop and peg floor stop.

2. 628 - Satin Aluminum: electromagnetic locks,

3. 630 - Satin Stainless Steel: pulls.

E . Keying: Provide in accordance with Section 08 71 00 'Door Hardware'

2.8 ELECTRICAL

A . Copper Conductors and Cables:

1. Flexible Conduit Cable: Manufacturers standard UL listed multi conductor fabricated of lightweight NEC Type FMC, high-strength aluminum alloy with 3, 5, or 8 insulated copper conductors in size #12 AWG factory assembled from the pre-terminated device.

a. Features:

1. Modular Wiring: Quick connect pre-terminated modular system for wiring modular devices per shop drawings.

2. Extender Cable: Quick connect pre-terminated at both ends modular system for wiring modular devices per shop drawings.

3. Power Whip: Manufacturer standard modular connector at one end and Pig Tail conventional hard wire connection at opposite end for connection to base building branch circuit conductor per drawings and Division 26 requirements.

2. Express Line Modular Cable: UL listed cable assembly for connecting Modular Panel Manager to pre-terminated modular assemblies. Composed of manufacturers standard lightweight NEC Type FMC, high-strength aluminum alloy with 3, 5 or 8 insulated copper conductors in size #10 AWG.

a. Features:

1. Length: Up to 150 feet (45.72 m).

3. Modular Splitter: Modular cable quick connect device for power distribution to be secured to wall, floor or above ceiling per shop drawings.

4. Conventional Cable: Power conductors and cables not provided by manufacturer are provided in accordance with division 26.

B . Conduit:

1. Electric Metal Tubing (EMT): Conduit pathways 1/2 inch (13 mm) or 3/4 inch (19 mm) factory mounted within the integrated interior assembly framing, from outlet junction box to top or bottom of assembly to permit wiring installation and connections as specified in Divisions 26, 27, and 28.

a. Material: Coated steel.

b. Feature: Provide with manufacturers standard plastic grommet at one end.

2. Flexible Metal Conduit: Provide UL listed flex conduit per ANSI/UL-1, NEC Type FMC fabricated of lightweight, high-strength aluminum alloy.

3. Refer to Division 26, 27, and 28 for additional conduit raceway and pull-string requirements.

C . Outlet Junction and Pull Boxes

1. Conventional back box and mounting bracket: Factory mounted.

2. Manufacturers standard back box and mounting bracket: Factory mounted.

3. Specialty Back Box: Provide to manufacturer for factory mount.

D . Face Plates and Trim Rings:

1. Manufacturer standard faceplates: Factory provided, Factory installed

a. Color: [White] [Ivory] [Grey] [Black] [Stainless Steel]

b. Construction: 2 adjustment screws at top and bottom for flush installation.

2. Manufacturer standard trim rings: Factory provided, site installed.

a. Color: [White] [Ivory] [Grey] [Black]

3. Conventional face plates: Provide in accordance with division 26 requirements.

4. Engraving/Identification: Provide in accordance with division 26 requirements.

E . Wiring Devices

1. Pre-terminated 15 or 20 amp receptacle factory assembled in outlet junction box.

a. Color: White except as follows: [Red for emergency circuits] [Ivory] [Orange] [Grey] [Blue] [Black]

b. Ground Pin Orientation: [Down] [Up] [Left] [Right]

c. USB charging port as located per drawings: Type A, 5 amp, 5 volt

F . Electrical Branch Circuiting:

1. Modular Zone Distribution: Modular Zone boxes designed to hold 12 circuits (independent neutrals) or 16 circuits (shared neutrals) site installed per shop drawings.

a. Connections from modular devices to modular zone box with site installed modular splitters and extender cables.

b. Connection of modular zone boxes to conventional panel: Home run connections provided in accordance with requirements of Division 26 Electrical and manufacturers installation instructions.

2.9 COMMUNICATIONS

A . Conduit:

1. Provide in accordance with section 13 42 75 Integrated Interior Assemblies electrical article above.

2. Manufacturers proprietary aluminum 1 x 2 inch (25mm x 50mm) rectangular aluminum conduit factory mounted to integrated interior assembly framing from device box to top or bottom of assembly to permit wiring installation and connections as specified in Division 27.

B . Outlet Junction and Pull Boxes:

1. Conventional back box and mounting bracket: Factory mounted.

2. Modular back box and mounting bracket: Factory mounted.

3. Specialty Back Box: Provide to manufacturer for Factory mounting.

C . Horizontal Cabling:

1. Provide in accordance with Division 27 requirements.

D . Face Plates and Trim Rings:

1. Modular faceplates: Factory provided, Factory installed
   a. Color: [White] [Ivory] [Grey] [Black] [Stainless Steel]
   b. Construction: 2 adjustment screws at top and bottom for flush installation.

2. Modular trim rings: Factory provided, site installed.

   a. Color: [White] [Ivory] [Grey] [Black]

3. Conventional face plates: Provide in accordance with Division 27 requirements.

4. Engraving/Identification: Provide in accordance with Division 27 requirements.

E . Data Jack:

1. Provide in accordance with Division 27 requirements.

2.10 MECHANICAL/PLUMBING ACCOMMODATION

A . Mechanical Chase: Manufacturers standard weldments and sheet metal spanning plates for accommodating in wall mechanical systems and/or plumbing.

1. Dimensions at 4 inch (102mm) thick wall: 6 inch (152mm) width minimum x 16 inch (406mm) width maximum with an interior depth of 2.5 inch (64mm) of clear space for accommodating assemblies.

   a. Maximum width dimension may exceed 16 inches (305mm) with manufacturer review and approval.

2. Dimensions at 6 inch (152mm) thick wall: 6 inch (152mm) width minimum x 16 inch (305mm) width maximum with 4.5 inches (114mm) of clear space for accommodating assemblies.
    a. Maximum width dimension may exceed 16 inches (305mm) with manufacturer review and approval.

B . Mechanical/Plumbing system assemblies: Provide as specified by appropriate section.

2.11 SITE INTEGRATED COMPONENTS

A . Door Hardware – per division 08 and 28

2.12 ACCESSORIES

A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B . Manufacturer's accessories required by the project:

1. Manufacturer Standard Base Trim: Mechanically fastened recessed and adjustable to accommodate gaps between assembly and base building elements.
    a. Color: Black
2. Manufacturer Standard Ceiling Trim: Mechanically fastened recessed and adjustable to accommodate up to a 1/2 inch (13 mm) gap between assembly and base building elements.
    a. Color: Black
3. Ceiling Perimeter Hanger: Manufacturer provided 1-1/8 inch (29mm) exposed perimeter edge angle extrusion for supporting lay-in panel ceiling systems. Seismic Suspension Edge Clips to meet code required movement without 2 inch (51mm) wall angles and all other acoustical ceiling components per section 09 51 00 Acoustical Ceilings.
4. Integrated Display Panel Edge Profile: Manufacturers standard trim for finishing edge of cutouts at finish panels with integrated display not behind glass.
    a. Color: TBD

PART 3 - EXECUTION

3.1 EXAMINATION

A . Verify existing conditions meet the manufacturer's requirements before starting work.

1. Floor Levelness:
    a. Contiguous wall lengths less than 40 feet: Base building sub-floor shall be level within 3/8 inch over 10 feet.
    b. Contiguous wall lengths greater Than 40 feet: Base building sub-floor shall not exceed a maximum total floor flatness deviation greater than 1-1/8 inches.
2. Vertical leading edge of assembly framing to base building: Where partitions attach to adjacent walls, the finish face shall be plum within 1/2 inch over 10 feet.
3. Top of assembly framing to base building: Where partitions attach to bulkhead or soffit, the finish face shall be level within 1/2 inch over 10 feet.

4. Lay in Ceilings: Where partitions attach to lay-in ceiling grid, the grid shall be level within 1/4 inch over 10 feet.

B . Verify field or hold-to control dimensions before fabrication of integrated interior assemblies. Coordinate fabrication schedule with construction schedule and progress to avoid delay in the work.

C . Examine all adjoining work including work by others.

D . Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

B . Locations to receive integrated interior assemblies shall be inspected for compliance with manufacturers requirements.

C . Survey floor to determine the nature of floor level and determine where special conditions exist beyond manufacturer’s standard leveling capabilities of 1-1/2 inch (38mm) total variation in floor level. Prepare sub-floor per section 03 54 00 ‘Cast Underlayment.’

D . Field conditions and pre-existing installations by others which may adversely affect installation or exceed the manufacturers limitations shall be corrected before installing walls.

3.3 INSTALLATION

A . General: Install all materials in accordance with manufacturer's instructions based on conditions present and pre-installation meeting.

B . All building services shall be installed and connected to the base building systems by licensed subtrades. All building services shall be inspected by authorized trade representatives and Authority Having Jurisdiction in the presence of a manufacturer representative. Coordinate with all affected parties as required.

C . Doors and frames

1. Install sliding doors plumb, level, square, and in proper alignment.
2. Install doors to close against walls without gaps
3. Install doors to open and close smoothly.
4. Anchor sliding doors securely to supports.

D . Electrical:

1. Electrical testing requirements provided in accordance with Division 26 Electrical.
2. Inspect all electrical installations as part of conventional electrical scope prior to installation of finish panels.
3. Installation sequence as determined by the certified installer and coordinated with the General Contractor based on project conditions.

E . Communications:

1. Communications testing requirements provided in accordance with Division 27 Communications.

F . Mechanical/Plumbing Accommodation:

1. Rough-in of vertical plumbing piping, provided by Division 22, shall be completed prior to the installation of the integrated interior assemblies. Horizontal and flexible plumbing piping is roughed in after assembly of the wall frame.
2. Carrier arms and stanchions at integrated interior assemblies required for the support of plumbing fixtures shall be provided in accordance with division 22 requirements. Coordinate locations and type with integrated interior assemblies' provider.
3. Provide dimensions of the roughed-in piping to the integrated interior assemblies supplier for coordination of the holes through the finish panels.
4. Coordinate installation of mechanical system assemblies with the integrated interior assembly supplier as required by the system

3.4 FIELD QUALITY CONTROL

A . Electrical:

1. All building services shall be inspected by authorized trade representatives and the local building authority prior to installation of finishing panels. Refer to Shop Drawings for location of components incorporated into prefabricated walls.
2. In general, installation locations and dimensions are installed a typical distance from prefabricated wall edges, refer to Shop Drawings for more information.

B . Communications:

1. Install communications systems in accordance with Division 27 requirements.

C . Mechanical/Plumbing:

1. Install plumbing systems in accordance with Division 22 requirements.
2. Install mechanical systems in accordance with Division 23 requirements.

3.5 ADJUSTING

A . Adjust and lubricate hardware for proper operation in accordance with manufacturer's instructions.

B . Doors and Frames

1. Adjust for smooth and balanced door movement in accordance with manufacturer's instructions.
2. Adjust and lubricate hardware for proper operation.

3.6 CLEANING

A . Dispose of all waste material in accordance with Section 01 74 19 'Construction Waste Management and Disposal' and project's Waste Management Plan.

B . Upon completion of installation clean finishes in accordance with the manufacturer's instructions. Avoid alkaline or abrasive agents. Avoid scratching or marring finishes.

3.7 PROTECTION

A . Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.8 DEMONSTRATION

A . Manufacturer’s representative will be responsible to provide general product training to the Owner or their outsourced operations team at time of installation as well as conduct a comprehensive training session(s) to convey the methodology, and assembly of the walls to sustain general operational maintenance by the Owner’s personnel with clearance over the facilities lifetime.

3.9 FINISH SCHEDULE

A . (PNT-1) ChromacoatPlus Paint:

1. Type: Standard.
2. Manufacturer: DIRTT.
3. Color Name: Fog.

B . (PNT-2) ChromacoatPlus Paint:

1. Type: Standard.
2. Manufacturer: DIRTT.
3. Color Name: Slate.

C . (PNT-3) ChromacoatPlus Paint:

1. Type: Color Match.
2. Manufacturer: DIRTT.
3. Color Name: Custom Graphics.
4. Notes: Weight Room.

D . (THRM-1) Thermofoil:

1. Type: Manufacturer Standard
2. Grade: 2
3. Color Name: Arturo Candlelight.
4. Grain Direction: Vertical
5. Notes: Doors & Casework.

E . (PWD-1): Powder Coat

1. Type: Manufacturer Standard.
2. Texture: Textured
3. Color Manufacturer: DIRTT.
4. Color Name: Black.
5. Notes: Doors, Frames, Corner Posts (as specified).

F . (PWD-2): Powder Coat
1. Type: Color Match.
2. Texture: Textured
3. Color Manufacturer: DIRTT.
4. Color Name: Gold.
5. Notes: Doors, Frames, Corner Posts (as specified).

G . (GLS-1) Glass:
1. Type: Tempered
2. Color/Finish: Manufacturer Standard Clear
3. Thickness: 10mm
4. Color Manufacturer: DIRTT.
5. Color/Finish Name: Clear.
6. Notes: Glass Walls.

H . (GLS-2) Glass:
1. Type: Tempered
2. Color/Finish: Manufacturer Standard Back Painted.
3. Thickness: 6mm
4. Color Manufacturer: DIRTT.
5. Color/Finish Name: Color TBD.
6. Notes: Kitchen Backsplash.

I . Finish Panels:
1. (MCF-1): WriteAway
   a. Type: Manufacturers Standard Solid Color
   b. Color/Pattern Manufacturer: DIRTT.
   c. Color: Buttercup
   d. Sheen: Gloss
   e. Notes: Accent Brand.
2. (MCF-2): WriteAway
   a. Type: Custom Graphic.
   b. Color/Pattern Manufacturer: DIRTT.
   c. Sheen: Matte or Gloss
   d. Notes: Accent Wall as indicated in drawings.

END OF SECTION

SECTION 14 20 00 - ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes: Requirements including but not limited to:
   1. Hydraulic passenger elevators.
   2. Equipment, machines, controls, systems and devices necessary for operation.
   3. Materials and accessories necessary to complete the elevator installation.

1.3 DEFINITIONS

A. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

B. Definitions in ASME A17.1/CSA B44 apply to work.

C. Service Elevator: A passenger elevator that is also used to carry freight.

1.4 SUBMITTALS

A. Product Data: Technical data including capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures; hoistway entrances; and operation, control, and signal systems.

B. Shop Drawings: Submit plans, elevations, sections, and large scale details indicating service at each landing; machine room layout; coordination with building structure; relationships with other construction; and locations of equipment.
   1. Include large scale layout of car control station.
   2. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as maximum and average power demands.

C. Manufacturer Certificates: Signed by elevator manufacturer, certifying that hoistway, pit, and machine room layout and dimensions, shown on Drawings, and electrical service, shown and specified, are adequate for elevator system being provided.

D. Submittals:
   1. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
   2. Set of service tools.
   3. Provide one electronic copy and two hard copies of manuals and inspection reports. Provide two complete printed sets of service, parts, schematic diagrams and adjustment manuals. Prints required by state code for each elevator.

4. Provide four copies of independent service keys. Provide 4 factory cut keys for every lock on each elevator and label use. Provide two extra copies of the independent service key for a total of 6 keys.
5. Final inspection by the state inspector shall have a School District representative present to observe. Complete the final documentation for the State Inspection and return to the School District Maintenance Department.
    a. The Owner shall apply for the operation/inspection certificate provided by the State Inspector. Cost of the state inspection shall be paid by the elevator subcontractor/ manufacturer.

E. Operation and Maintenance Data: Submit for elevators to include in emergency, operation, and maintenance manuals and parts list, with recommended parts inventory.

F. Inspection and Acceptance Certificates and Operating Permits: Required by authorities having jurisdiction for normal, unrestricted elevator use.

G. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a two year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options. Maintenance agreement includes but is not limited to:
1. Systematic examination, adjustment, and lubrication of all elevator equipment.
2. Repair or replacement of electrical and mechanical parts of the elevator installation as required, using only the genuine standard parts approved for the original installation.
3. Maintenance work as required during regular working hours and regular working days, but with emergency callback service available at all times during this maintenance period.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Building Code: Comply with applicable provisions of the IBC and the Elevator Code.
2. Elevator Standard: Comply with ASME A17.1/CSA B44.
3. Fire Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 and IBC.
4. Accessibility Requirements: Comply with applicable requirements.
    a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
    b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    c. Texas Accessibility Standards (TAS) 2012.

B. Manufacturer/Installer Qualifications: Elevator manufacturer having minimum 10 years documented experience who is trained and approved by manufacturer, including but not limited to:
1. Manufacturer of the power unit, controller, signal fixtures, door operators cab, entrances, and other major parts of the elevator operating equipment.
2. Primary and major equipment components are manufactured in the United States and are not be an assembled system.
3. Documented, ongoing quality assurance program.

C. Source Limitations: Obtain elevators through one source from a single manufacturer.
1. Provide major elevator components, including pump and tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.

D. Inspection and Testing: Elevator Installer shall obtain and pay for required inspections, tests, permits and fees for elevator installation.
   1. Arrange for inspections and make required tests.
   2. Deliver documentation to the Owner upon completion and acceptance of elevator work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.7 COORDINATION

A. Coordinate dimensions with structure, walls, and adjacent features.

B. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

C. Furnish well casing and coordinate delivery with related excavation work.

D. Coordinate locations and dimensions of other work specified that relates to hydraulic elevators, including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.8 WARRANTY

A. Written warranty signed by manufacturer in which manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
   2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturer: Hydrofit by Otis Elevator.

B. Elevator System: Machine roomless, holeless hydraulic elevator system with standard components included in elevator systems necessary for complete system.

C. Elevator Description:
   1. Rated Load: 3500 lb (1135 kg).
   2. Rated Speed: 100 fpm (0.51 m/s).
   3. Operation System: Single automatic operation.
   4. Car Enclosures:
      a. Inside Width: 78 inches (1980 mm) from side wall to side wall.
      b. Inside Depth: 51 inches (1295 mm) from back wall to front wall (return panels).
      c. Inside Height: Not less than 93 inches (2362 mm) to underside of ceiling.

d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
e. Car Fixtures: Satin stainless steel, No. 4 finish.
f. Side and Rear Wall Panels: Satin stainless steel, No. 4 finish.
g. Reveals: Black.
h. Door Faces (Interior): Satin stainless steel, No. 4 finish.
i. Door Sills: Nickel silver.
j. Ceiling: Luminous ceiling.
k. Handrails: 1/2 inch by 2 inches (13 by 50 mm) rectangular, at rear of car.
l. Floor prepared to receive resilient flooring.

5. Hoistway Entrances:
   a. Width: 42 inches (1067 mm).
   b. Height: 84 inches (2134 mm).
   c. Type: Single speed center opening.
   d. Frames: Satin stainless steel, No. 4 finish.
   e. Doors: Satin stainless steel, No. 4 finish.
   f. Sills: Nickel silver.
6. Hall Fixtures: Satin stainless steel, No. 4 finish.
7. Additional Requirements:
   a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
   b. Provide hooks for protective pads and one complete set of full height protective pads.

2.2 SYSTEMS AND COMPONENTS

A. Pump Units: Positive displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
   1. Pump shall be submersible type with submersible squirrel cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts.
   2. Motor shall have solid state starting.
   3. Motor shall have variable voltage, variable frequency control.

B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation absorbing material in blowout proof housing at pump unit.

C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
   1. Cylinder units shall be connected with dielectric couplings.
   2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

D. Hydraulic Fluid: Nontoxic, biodegradable**, fire resistant** fluid, made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal passivating additives, that is approved by elevator manufacturer for use with elevator equipment.

E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified Section 055000.

F. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than 1 inch (25 mm) clearance from cylinder and extending above pit floor. Casing shall have means of monitoring effectiveness to comply with ASME A17.1/CSA B44.

G. Corrosion Protective Filler: A nontoxic, petroleum based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify at temperatures below 60 degrees F (16 degrees C).

H. Car Frame and Platform: Welded steel units.

I. Guides: **Roller guides; p**rovide guides at top and bottom of car frame.

2.3 OPERATION SYSTEMS

A. Provide standard microprocessor operation system required to provide type of operation indicated.

B. Auxiliary Operations:
1. Single Car Standby Powered Lowering: On activation of standby power, car is lowered to the lowest floor, opens its doors, and shuts down.
2. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after 5 minutes and are re-energized before car doors open.

2.4 DOOR REOPENING DEVICES

A. Infrared Array: Provide door-reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door-reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.5 CAR ENCLOSURES

A. Provide **steel framed car enclosures with nonremovable** wall panels, with **removable** car roof, access doors, power door operators, and ventilation.
1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Standards, but not less than the following:
1. Subfloor: Exterior, underlayment grade plywood, not less than 5/8 inch (15.9 mm) nominal thickness.
2. Floor Finish: Refer to Section 096500.
3. Stainless Steel Wall Panels: Flush, formed metal construction; fabricated from stainless steel sheet.
4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
6. Stainless Steel Doors: Flush, hollow metal construction; fabricated from stainless steel sheet or by laminating stainless steel sheet to exposed faces and edges of enameled or powder coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
7. Sight Guards: Provide sight guards on car doors.
8. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
9. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
10. Light Fixture Efficiency: Not less than 35 lumens/W.
11. Ventilation Fan Efficiency: Not less than 3.0 cfm/W (1.4 L/s per W).

2.6 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Horizontal sliding, door and frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
   1. Where gypsum board wall construction is indicated, frames shall be self supporting with reinforced head sections.

B. Fire Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
   1. Fire Protection Rating: 1 hour with 30 minute temperature rise of 450 degrees F (250 degrees C).

C. Materials and Fabrication: Standard, but not less than the following:
   1. Steel Subframes: Formed from cold or hot rolled steel sheet, with factory applied enamel or powder coat finish or rust resistant primer. Fabricate to receive applied finish as indicated.
   2. Stainless Steel Frames: Formed from stainless steel sheet.
   3. Stainless Steel Doors: Flush, hollow metal construction; fabricated from stainless steel sheet or by laminating stainless steel sheet to exposed faces and edges of enameled or powder coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil canning.
   4. Sight Guards: Provide sight guards on doors matching door edges.
   5. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
   6. Nonshrink, Nonmetallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.7 SIGNAL EQUIPMENT

A. Provide hall call and car call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal resistant buttons and lighted elements illuminated with LEDs.

B. Car Control Stations: Provide recessed or semirecessed car control stations. Mount in return panel adjacent to car door unless otherwise indicated.
   1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
   2. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two Way Telephone Communication Service: Provide flush mounted cabinet and required conductors in traveling cable for firefighters' two way telephone communication service.

E. Car Position Indicator: Provide digital type car position indicator, located above car door or above car control station. Provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

F. Hall Push Button Stations: Provide one hall push button station at each landing.
   1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
   2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.

G. Hall Lanterns: Units with illuminated arrows; however, provide single arrow at terminal landings. Provide the following:
   1. Wall mounted units, for mounting above entrance frames.

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
   1. At manufacturer's option, audible signals may be placed on cars.

I. Hall Position Indicators: Provide digital display type position indicators, located above hoistway entrance at ground floor.
   1. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
   2. Integrate ground floor hall lanterns with hall position indicators.

J. Standby Power Elevator Selector Switches: Provide switches, required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.

K. Fire Command Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

L. Emergency Pictorial Signs: Fabricate from materials matching hall push button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.8 FINISH MATERIALS

A. Cold Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

B. Hot Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

C. Stainless Steel Sheet: ASTM A 240/A 240M, Type 304.

D. Textured Stainless Steel Sheet: ASTM A 240/A 240M, Type 304, with embossed texture rolled into exposed surface.

E. Stainless Steel Bars: ASTM A 276, Type 304.

F. Stainless Steel Tubing: ASTM A 554, Grade MT 304.

G. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

H. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report listing conditions detrimental to performance of the work.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

D. Install piping above the floor, where possible. Install underground piping in casing.
   1. Excavate for piping and backfill encased piping according to applicable requirements.

E. Lubricate operating parts of systems recommended by manufacturers.

F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

G. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.

H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

I. Locate hall signal equipment for elevators as follows unless otherwise indicated:
   1. Place hall lanterns either above or beside hoistway entrance.
   2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Do not use elevator for construction purposes:

3.5 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator.

B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 24 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   1. Perform maintenance during normal working hours.
   2. Perform emergency callback service during normal working hours with response time of two hours or less.

END OF SECTION 14 20 00

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

C. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

D. SECTION 21 11 13 – FIRE SUPRESSION SYSTEMS

E. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT

F. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 SUMMARY

A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. Phased Construction:
1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational.
2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.

D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.3 QUALITY ASSURANCE

A. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.

B. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.

C. All materials and distribution, and utilization equipment shall be UL Listed.

D. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.

E. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner

1.4 QUALIFICATION OF CONTRACTORS

A. The Contractor for the fire protection installation shall be a certified fire protection contractor, licensed for the installation of automatic fire sprinkler systems and other fire protection equipment.

B. An approved contractor for the work under this division shall be:
1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
2. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas
3. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

1.5 DESIGN STANDARDS

A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:

1. The International Fire Prevention Code
2. The International Building Code
3. National Fire Protection Association (NFPA) Standards:
   a. NFPA 101 - Life Safety Code
   b. NFPA 13 - Installation of Sprinkler Systems
   c. NFPA 14 - Installation of Standpipe and Hose Systems
   d. NFPA 20 - Installation of Centrifugal Fire Pumps
   e. NFPA 24 - Installation of Private Fire Service Mains
   f. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems
   g. NFPA-2001 – Standard for Clean Agent Fire Extinguishing Systems

B. Factory Mutual (FM) Approval Guide

C. Underwriters Laboratories Inc. (UL)

D. Owner’s Insurance Underwriter Requirements

1.6 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.

D. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.7 WORK INCLUDED

A. Code compliance, research, design coordination, and installation or a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and sate regulations, and these specifications.

B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.

C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.

D. All permits and approvals of the fire protection system.

E. SYSTEMS: Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
1. Access Panels
2. Floor, Wall, and Ceiling Plates
3. Insulation
4. Heatrace
5. Piping and Equipment Identification
6. Painting

1.8 COORDINATION WITH OTHER TRADES

A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.

B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.

C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.

D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.

E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.

H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.

I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.9 DRAWINGS

A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.

B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical, electrical, plumbing and fire protection drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.

E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.10 ORDINANCES, PERMITS AND DRAWING APPROVALS

A. The Contractor shall file all requisite plans relating to this section of the specifications with the proper authorities, secure all permits and approvals and pay all resultant fees for work done under this section.

B. All fire protection work shall comply with all laws, ordinances, rules, regulations and standards of the City, County, State and the Owner’s Insurance Underwriter; all applicable sections of the National Fire Codes and the Codes and Standards of the National Fire Protection Association.

C. If code or other requirements exceed the provisions shown on the Contract Documents, the Architect shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor’s expense.

1.11 SUBSTITUTIONS

A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. See division 01 specification for additional requirements.

B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.

D. **No substitutions will be considered after the Award of Contract.**

E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:

1. Product data, drawings and descriptions of products, fabrication and installation procedures.
2. Samples, where applicable or requested.
3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
5. A statement indicating the effect the substitution will have on the Contractor’s Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
6. Cost information, including a proposal of the net change, if any in the Contract Sum.
7. Certification by the Contractor to the effect that, in the Contractor’s opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor’s waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer’s re-design and evaluation costs resulting from the use of the proposed substitution

F. Condition: The Contractor’s request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the

Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

1.12 SUBMITTALS

A. Provide shop drawings and complete product data as indicated in each specification section.

B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.

C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
   1. **Reviewed**: No further submittal action is required. Submittal to be included in O & M Manual.
   2. **Revise and Resubmit**: Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
   3. **Rejected**: Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnished product named in Specification and or Drawings.
   4. **Furnish as Corrected**: Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.

D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.

E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

F. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.

G. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.13 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.14 INTERFERENCE DRAWINGS

A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.

B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.15 EXISTING CONDITIONS

A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.

B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.

C. Work Sequence, Timing, Coordination with Owner:
   1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.

D. Demolition and Work within Existing Buildings:
   1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this Contract.
   2. All equipment and/or systems noted on the Drawings “To Remain” shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

3. All equipment and/or systems noted on the Drawings “To Be Removed” shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.
4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades separating work area from occupied areas.
5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
8. Make every effort to minimize damage to the existing building and the owner’s property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner’s activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation and plumbing services for the existing areas.
10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.
12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner’s representative in order to protect systems that shall remain in service.
13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
14. Refer to Architectural “Demolition and/or Alteration” plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

1.16 EQUIPMENT, MATERIALS, BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.

D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.17 PRECONSTRUCTION CONFERENCE

A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.18 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.19 GUARANTEE

A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.20 SPARE EQUIPMENT

A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
   1. Facilities with less than 300 sprinklers – 6 minimum
   2. Facilities with 300 to 1000 sprinklers – 12 minimum
   3. Facilities with over 1000 sprinklers – 24 minimum

1.21 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.

B. The original set of “as-built” drawings shall be scanned and transmitted to the Architect in both full size bond and PDF format.

C. As Build Drawings: 2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each, PDF Format and AutoCad 2015 files on disk (CD Rom).
   1. Number of Copies: Submit one set of marked up record prints.
   2. Number of Copies: Submit copies of record Drawings:
      a. Initial Submittal:
         1) Submit PDF electronic files of scanned record prints and one of file prints.
         2) Submit record digital data files and one sets of plots.
         3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Final Submittal:
         1) Submit PDF electronic files of scanned record prints and three sets of prints.
         2) Submit record digital data files and three sets of record digital data file plots.
         3) Plot each drawing file, whether or not changes and additional information were recorded.

D. As-Built drawings should indicate the following information as a minimum:
   1. Indicate all addendum changes to documents
   2. Remove Engineer’s seal, name, address and logo from drawings.
   3. Mark documents AS-BUILT DRAWINGS.
   4. Clearly indicate: DOCUMENT PRODUCED BY.
   5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
   6. Indicate exact location of all underground plumbing and flow line elevations.
   7. Indicate exact location of all underground mechanical piping and elevations.
   8. Indicate exact location of all underground electrical raceways and elevations.
   9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
   10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices,

and all deviations and changes from the construction documents in the work shall be recorded.

11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
12. Exact location of all electrical equipment in and outside of the building.
13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
15. Cloud all changes.

1.22 START-UP-SERVICE

A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.23 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Prior to final acceptance by the Owner, the Contractor shall provide three (3) copies of an Operations and Maintenance Manual, Bound, indexed, and titled in three-ring, loose-leaf binders. These manuals shall each contain the following:

1. Clear and concise instructions for operation, maintenance, adjustment, lubrication, wiring diagrams and trouble-shooting data for all mechanical equipment. This information shall be prepared by the manufacturer for particular size and model of equipment furnished.
2. Parts list of all parts for equipment, with catalog numbers and other data necessary for ordering of replacement parts.
3. Provide a competent manufacturer's service engineer for a minimum of two (2) days to instruct the operating personnel including the interpretation of all equipment diagrams. A diary of the training sessions shall be made by the instructing manufacturer's service engineer and witnessed by the Owner's representative and shall be included in the as-built submittal.
4. Copies of all approved equipment shop drawings, sprinkler layout drawings, hydraulic calculations and as-built plans shall be submitted with the Operation and Maintenance manual.
5. Index shall include type of equipment, manufacturer, and local representative with address and phone number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All sprinkler system equipment is to be UL Listed or FM Approved.

2.2 ACCESS PANELS

A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.

B. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.

C. Panels shall have flush doors with No.16 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.

D. Access panels are not allowed in gypsum ceilings in public spaces.

2.3 FLOOR, WALL & CEILING PLATES

A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.4 GALVANIC PROTECTION

A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings

2.5 INSULATION

A. The following shall be insulated:
   1. All fire suppression water piping above grade (outdoor).
   2. All fire suppression water piping above grade (un-condition space).
   3. Acceptable manufacturers:
      a. Manville Corporation.
      b. Certain-Teed.
      c. Owens Corning Fiberglass.
      d. Knauf Insulation.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Mineral-Fiber, Glass fibers bonded with a thermosetting resin complying with the following:
   1. Preformed Pipe Insulation: Comply with ASTM C 547, Type I, with factory-applied, all-purpose, vapor-retardant jacket.
   2. Blanket Insulation: Comply with ASTM C553, Type II, without facing.
   3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades

a. Class I, Grade A for bonding glass cloth and tape to un-faced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to un-faced glass-fiber insulation.
b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
c. Class 2, Grade A, and comply with MIL-A-3316C. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

4. Vapor-Retarder Mastics: Fire and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C 19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

F. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class I.
2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.

G. Field-Applied Jackets:
1. General: ASTM C 921, Type I, unless otherwise indicated.
2. Foil and Paper Jacket: Not acceptable.
3. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
a. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. PVC Jacket Color: White.
c. PVC Jacket Color: Color-code piping jacket as determined by existing conditions.
d. Not to be used for outdoors.
4. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil (0.75 mm) thick, high-impact, ultraviolet-resistant PVC.
a. Shapes: 45 and 90-degree, short and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
b. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
c. Not to be used for outdoors.
5. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
a. Finish and Thickness: Smooth finish, 0.010 (0.25 mm) inch thick.
b. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
c. Elbows: preformed 45 and 90-degree, short and long-radius elbows; same material, finish, and thickness as jacket.

6. Joint Sealants: For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Accessories and Attachments
1. Bands: stainless steel ASTM A666, Type 304, 3/4 inch (20 mm) wide; 0.02 inch (0.050 mm) thick.

I. Vapor Retardants
1. Mastics: Use materials as recommended by the insulation material manufacturer that are compatible with insulation materials, jackets, and substrates. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

2.6 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

A. Provide electric heat tracing on all domestic water piping and sanitary traps exposed to areas subject to freezing.

B. Provide a complete UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to prevent pipes from freezing.

C. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.

D. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.

E. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.

F. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.

G. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.

H. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.

I. Electric heating cable shall be Raychem XL-Trace or approved equal, 5 watts per foot.

J. All piping shall be insulated with 1" thick fiberglass insulation.

K. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2002.

L. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be

rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

2.7 PIPING SYSTEMS IDENTIFICATION

A. A marker showing the service and an arrow indicating the direction of flow shall be applied on the following equipment installed under this section of the Specifications:

1. All above ground fire protection standpipe and sprinkler piping
2. All above ground sprinkler drainage piping

B. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
1. Sprinkler piping
2. Drain piping
3. Pre-Action piping
4. Clean Agent piping
5. FDC piping

C. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.

D. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.

E. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag (stamped numbered tags). Provide Identification Tags on all Emergency fixture and unit or Shut off valves.

F. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.

G. Valve tags will include a “P” or “FP” lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems. All valves on pumps shall be similar to the valve tags specified above, except they shall be 2-1/2" in diameter, black with white number 2" high for attaching to valve stem by means of brass hook or small solid link brass chain. Tags shall be similar to Seton 2961-25.

H. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.

I. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.8 EQUIPMENT LABELING

A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, and other similar equipment.

B. Equipment labeling shall be one of the following, unless noted or specified otherwise.

1. Permanently attached plastic laminate signs with 1" high lettering.
2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

2.9 PAINTING

A. All piping exposed to public sight such as standpipe and drain piping in stairwells, or exposed to exterior or moisture conditions such as piping in parking decks, shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect.

B. All piping exposed to corrosive environment such as pool areas, pool equipment room, sanitization room, and acid room shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect

C. Contractor shall touch-up to match original finish any equipment scratched in shipment or installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.

B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.

C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.

D. All equipment and materials shall be installed according to manufacturer’s recommendations and shall meet the requirements of NFPA and the Owner’s Insurance Underwriter.

E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to

ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.

F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles.

G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.

H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.

I. Provide a pressure gauge at the top level of all standpipes.

J. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.

K. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24” above any finished ceiling.

L. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.

M. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, storage rooms and all unfinished areas where the head is less than 7 feet-6 inches above finished floor.

N. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.

O. Building shall be 100 percent fully sprinklered.

P. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.

Q. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.

R. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5” and 2.5” fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.

S. Maintain a minimum 3’ horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.

T. Provide protection in all gymnasium areas.

U. If a deluge system in required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 PREPARATION

A. Arrangements shall be made to have the openings, inserts, sleeves, blockouts, and such other incidentals set in place ahead of the construction work, where practical, to eliminate the need of cutting and patching. If coring becomes necessary for installation of the work, it shall be done under this section. All holes shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect. All coring shall be performed in a manner not to weaken the structural parts and the manner and method shall be submitted to the Structural Engineer for approval.

3.4 SLEEVES AND ESCUTCHEONS

A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.

B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.

C. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.

D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.

E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.

F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.

G. Sleeves through interior masonry partitions shall be of 22-gauge galvanized sheet steel.

H. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.

I. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer’s approval.

J. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.

K. Escutcheons shall be provided around all exposed pipe passing through walls, partitions, ceilings and floors in finished spaces. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling.

L. Supply piping (domestic and /or fire water) shall not pass under footings or through grade beams unless noted otherwise.

3.5 CLEANING

A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.

B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.

C. Remove all trash and debris from site and dispose of legally.

D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.6 DEMONSTRATION

A. To obtain complete and final acceptance of the fire protection system, all inspections, approvals, examination and acceptance tests required by the Authority Having Jurisdiction shall be arranged and paid for under this Section.

B. Sprinkler Contractor shall provide necessary equipment and test materials for testing of the installation.

C. Testing of the completed sprinkler system for acceptance shall be witnessed by an Owner’s representative. Testing should be coordinated with the Authority Having Jurisdiction.

D. Provide the Owner with as-built drawings and equipment data at completion of construction. As-built drawings shall include an overall graphic drawing of areas covered by each sprinkler zone. This is to include auxiliary drains and inspector test locations. This is to be updated and displayed at riser room. New graphic to include existing systems.

E. Complete set of as-built drawings (Per NFPA) to be provided to document box at FACP. Drawings to include hydraulic calculation plate information. As-built to be provided in cad and PDF formats to district.

F. Zone calculation plates to be permeant type (metal or laminate) with printed information attached to each riser.

G. Provide completed Underground and Aboveground Contractor’s material and Test Certificates per NFPA 13 at time of acceptance of test.

H. Inspections test to be piped into nearest drain to support flow.

3.7 PAINTING

A. Where exposed in any MEP equipment room, all fire protection piping shall be painted red.

B. Paint prior to the installation of sprinkler heads; replace any sprinkler heads that come in contact with paint with new heads.

3.8 WORKMANSHIP

A. All work shall be coordinated with the work to be performed or installed under other sections of these Specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. Offsets shall be provided as required to avoid interference and conflicts with other work, to maximize headroom, or to improve the appearance of pipe runs. All pipe supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.

E. The subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

3.9 ERECTION AND INSTALLATION

A. Installation and workmanship requirements are specified hereinafter.

B. This subcontractor shall be responsible for the furnishing and installing of all support steel, hangers, rods, clamps, etc., to provide adequate support of all Fire Protection equipment specified herein. All support assemblies shall be UL Listed or FM Approved.

3.10 TESTS

A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the “Contractor’s Materials and Test Certificate” shall be submitted to the Architect.

B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a

test inspection. Sectional tests shall be made before insulation or concealing any piping.

C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.

D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.

E. Prior to final acceptance by the Owner, submit the “Contractor’s Material and Test Certificates” indicating system compliance with all applicable sections of NFPA.

3.11 INSTRUCTION OF OWNER’S PERSONNEL

A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
   1. Provide the training during the Owner's regular working day.
   2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.

B. Time to be allocated for instructions.
   1. Minimum of 8 hours dedicated instructor time.
   2. 4 hours on each of 2 days.

C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
   1. One copy to the Owner.
   2. One copy to the Architect/Engineer.

D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.

E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, arid the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operation and Maintenance Manual”:

3.12 OPERATION AND MAINTENANCE MANUALS

A. Form of Manuals:
   1. Prepare data in form of an instructional manual for use by Owner's personnel.
   2. Format:
      a. Size: 8-1/2" x II".
      b. Text: Manufacturer's printed data or neatly typewritten
   3. Drawings:
      a. Provide reinforced punched binder tab and bind in text.
      b. Fold larger drawings to size of text pages.
   4. Provide fly leaf indexed tabs for each separate product or each piece of operating equipment
   5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
      a. Title of Project
      b. Identity of separate structures as applicable.
      c. Identity of general subject matter covered in the manual
   6. Binder as specified.

B. Content of Manual:
   1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
      a. Contractor, name of responsible principal, address and telephone number.
      b. A list of each product required to be included, indexed to content of the volume.
      c. List with each product, name, address and telephone number of:
         1) Subcontractor or installer
         2) Maintenance contractor as appropriate.
         3) Identify area of responsibility of each
         4) Local source of supply for parts and replacement
      d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
   2. Product Data:
      a. Include those sheets pertinent to the specific product.
      b. Annotate each sheet to:
         1) Identify specific product or part installed.
         2) Identify data applicable to installation.
         3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner).
   3. Drawings:
      a. Supplement product data with drawings as necessary to illustrate:
         1) Relations of component parts of equipment and systems.
         2) Control and flow diagrams.
      b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
      c. Do not use Project Record Documents as maintenance drawings.
   4. Written text, as required to supplement product data for the particular installation:
      a. Organize in consistent format under separate headings for different procedures.
      b. Provide logical sequence of instructions for each procedure.
   5. Copy of each warranty, bond and service contract issued.
      a. Provide information sheet for Owner's personnel, giving:
         1) Proper procedures in event of failure.
         2) Instances that might affect validity of warranties or bonds
   6. Shop drawings, coordination drawings and product data as specified.

C. Sections for Equipment and Systems
   1. Content for each unit of equipment and system as appropriate:
      a. Description of unit and component parts
         1) Function, normal operating characteristics, and limiting conditions.
         2) Performance curves, engineering data and tests.
         3) Complete nomenclature and commercial number of replaceable parts
      b. Operating procedures:
         1) Start up, break-in, routine and normal operating instructions.
         2) Regulation, control, stopping, shut down and emergency instructions.
         3) Summer and winter operating instructions.
         4) Special operating instructions
      c. Maintenance procedures:
         1) Routine operations
         2) Guide to trouble-shooting.
         3) Disassembly, repair and reassembly.
         4) Alignment, adjusting and checking.
         5) Routine service based on operating hours.
      d. Servicing and lubrication schedule. List of lubricants required.
      e. Manufacturer's printed operating and maintenance instructions.
      f. Description of sequence of operation by control manufacturer
      g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
         1) Predicted life of part subject to wear.
         2) Items recommended to be stocked as spare parts.
      h. As installed control diagrams by controls manufacturer.
      i. Complete equipment internal wiring diagrams.
      j. Each Contractor's coordination drawings.
      k. As installed color coded piping diagrams.
      l. Charts of valve tag number, with location and function of each valve.
      m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
      n. Other data as required under pertinent sections of the specifications.
   2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
   3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
   4. Provide complete information for products specified in Division 23.
   5. Provide certificates of compliance as specified in each related section.
   6. Provide start up reports as specified in each related section.
   7. Provide signed receipts for spare parts and material.
   8. Provide training report and certificates.
   9. Provide backflow preventer certified test reports.

END OF SECTION 21 05 00

SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.

C. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

D. SECTION 21 11 13 – FIRE SUPRESSION SYSTEMS.

E. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT

F. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 DESCRIPTION

A. This section describes the following:
1. Hangers, supports and anchors for the fire protection equipment, tanks and piping systems.
2. Supplementary steel for support or attachment of fire protection tanks, equipment and piping to general construction elements of the project.

1.3 REFERENCES

A. General:
1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

B. Code of Federal Regulations 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL).

C. National Fire Protection Association (NFPA):
1. NFPA-13 Installation of Sprinkler Systems.
2. NFPA-14 Installation of Standpipe and Hose Systems.

D. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA):
1. Seismic Restraint Manual: Guidelines for Mechanical Systems - latest edition for the support of ductwork.

E. UL Fire Resistance Directory, latest edition.

1.4 SUMMARY

A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

B. Section Includes:
1. Pipe, duct, and equipment hangers and supports.
2. Anchors, equipment bases and supports.
3. Sleeves and seals.
4. Flashing, counter flashing and pipe stacks.
5. Firestopping.

1.5 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.6 SUBMITTALS

A. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

C. Manufacturer's Installation Instructions:
1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Submit calculations showing compliance with Division 01 Section "Lateral Force Procedures" for seismic bracing of ductwork and piping.

1.7 QUALITY ASSURANCE

A. Comply with Division 21 Section "Common Results for Fire Suppression."

B. Supports for Sprinkler Piping: Comply with NFPA 13.

C. Supports for Standpipes: Comply with NFPA 14.

D. Do not use black steel devices, components, fasteners, etc. within the Clean Room interstitial space or in any related air flow path. Steel items shall be plated, galvanized, painted, or coated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.

C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
1. Unistrut Corp.
2. B-Line Systems.
3. Grinnell.
4. Superstrut,
5. Anvil.

B. Pipe Supports:
1. Conform to MSS SP58.
2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring, UL listed, Grinnell Fig. 69 or equal. Use plastic coated hangers at all uninsulated copper piping.
3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, black or galvanized, adjustable, clevis, UL listed, Grinnell Fig. 260 or equal.
4. Multiple or Trapeze Hangers: 12 gauge (2.67 mm) channel complete with nuts, pipe clamps, pipe straps, and drive-in end caps. Furnish cushion strip on all uninsulated copper piping and; cast iron roll and stand for hot pipe sizes 6 inches and over.
5. Pipe Supported Tight to Wall, Floor, or Ceiling: Superstrut A1200, Unistrut P1000, or equal, 12 gauge channel complete with pipe clamps, nuts, bolts, and end caps. Furnish cushion strip on all uninsulated copper piping and adjustable steel yoke and cast iron roll for hot-pipe sizes 6 inches and over.
6. Vertical Support: Steel riser clamp, UL listed, Grinnell Fig. 261, Superstrut C720, or equal.
7. Floor Support for Pipe Sizes to 4 Inches (101.6 mm) and Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
8. Floor Support for Hot Pipe Sizes 6 Inches (152.4 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
10. CPVC Tube Support: CTS sized hangers or supports free of sharp edges.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 ATTACHMENT TO STRUCTURE

A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

B. Connection to Existing Concrete Structure: Concrete anchors conforming to Division 03 Section “Concrete Accessories”.

C. For Suspension from New Formed Concrete Structure: B-Line B3014, Grinnell Figure 282, Superstrut 452, or equal, adjustable concrete insert.

D. For Support on New Concrete: Galvanized steel headed bolts.

E. Welded Connection to Steel Beams: B-Line B3083, Grinnell, Superstrut, or equal, steel welded beam attachment.

F. Clamp Connection to Steel Beams: B-Line, Grinnell, Superstrut, or equal, beam clamp with retaining clip style as required by load.

2.4 SUPORTS, BRACING, AND ACCESSORIES

A. Miscellaneous Steel: Angles, channels, brackets, rods, clamps, etc., of new materials conforming to ASTM A36. Hot-dip galvanize all steel parts after fabrication where used outdoors or inside the penthouse.

B. Fasteners: All bolts and nuts, except as otherwise specified, shall conform to ASTM Standard Specifications for Low Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A307. Bolts shall have heavy hexagon heads, and nuts shall be of the hexagon heavy series. All bolts, washers, nuts, anchor bolts, screws and other hardware used outdoors or inside the penthouse shall be galvanized, and all galvanized nuts shall have a free running fit. Provide bolts of ample size and strength for the purpose intended. All ferrous metal components below grade shall be stainless steel.

C. Sheet Metal Screws: Plated, size 10 minimum.

D. Pre-engineered duct and pipe bracing systems may be Mason Industries Seismic Sway Brace System or equal.

2.5 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel.

B. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Provide stainless steel sheet metal for exterior walls.

C. Sealant: Acrylic

2.6 MECHANICAL SLEEVE SEALS

A. Manufacturers:
   1. Thunderline Link-Seal, Inc., or approved equal.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

A. Manufacturers:
1. Unistrut Corp., or approved equal.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.8 FIRESTOPPING

A. Manufacturers:
1. Dow Corning Corp. Model.
2. 3M fire Protection Products Model.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: Dark gray Black As selected from manufacturer’s full range of colors.

D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer’s system selector for more information.

2.9 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.
4. Plywood or particle board.
5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:
1. Furnish UL listed products or products tested by independent testing laboratory.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing or damming materials to arrest liquid material leakage.

D. Do not drill or cut structural members.

E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.

F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with MSS SP 58.

B. Beam clamps shall only be used on beams. It is acceptable to use clamps on the top cord of the joist within 3” of the panel point but never on the bottom cord of the joist at any location. It is also acceptable to route a vertical all-thread thru the middle of the joist.

C. Supports for Gas Piping:

1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.

G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

I. Support riser piping independently of connected horizontal piping.

J. Provide copper plated hangers and supports for copper piping.

K. Design hangers for pipe movement without disengagement of supported pipe.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

M. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

N. Support PEX tubing every 32 inches unless a continuous support such as Uponor PEX-a Pipe Support is used. Then:
1. ½ - ¾ inch pipe: 6 feet
2. 1 – 3 inch pipe: 8 feet

O. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.

E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.

F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.

D. Fire Rated Surface:
   1. Seal opening at floor and wall as follows:
      a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
      b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
      c. Pack void with backing material.
      d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

E. Non-Rated Surfaces:
   1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
      a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
      b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
      c. Install type of sealant or caulk suitable for application.
   2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
   3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 21 05 29

SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.

C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

D. SECTION 21 11 13 – FIRE SUPRESSION SYSTEMS.

E. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT

F. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS

1.2 DEFINITIONS

A. IBC: International Building Code.

1.3 PERFORMANCE REQUIREMENTS

A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.

B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.

C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.

D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35 inch deflection.

E. All elastomeric isolators shall be of high quality synthetic rubber with anti-ozone and anti-oxidant additives.

F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be

epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs./sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.

H. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.

I. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.

J. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.

K. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
   1. Offices
      a. Executive: 30
      b. Conference rooms: 30
      c. Private: 35
      d. Open-plan areas: 35
      e. Computer/business machine areas: 40
      f. Public circulation: 40

   2. Schools
      a. Lecture and classrooms: 30
      b. Open-plan classrooms: 35

   3. Libraries: 25
   4. Theaters
      a. Theater: 25
      b. Stage house: 25
      c. Trap room: 25
      d. Orchestra pit: 25
      e. Rehearsal rooms: 25
      f. Teaching studios: 30
      g. Practice rooms: 30
      h. Ensemble rooms: 30
      i. Shop: 45

1.4 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.

C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.

D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.

E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.

H. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. All fire suppression systems vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

A. All vibration isolators described in this section shall be the product of a single manufacturer. . Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.
   1. Manufacturers:
      a. Mason Industries
      b. Kinetics Noise Control
      c. Amber / Booth
      d. Vibration Eliminator

B. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the pad, load

distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

C. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.

D. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

E. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.

F. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.

G. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.

H. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

I. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.

J. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.2 BASES

A. Type WF: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.

C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where space is a problem. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2 inches above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt

sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

2.3 FLEXIBLE PIPE CONNECTIONS

A. Type SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR: Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14"shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14"shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2"thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

2.4 MECHANICAL ANCHOR BOLTS

A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.5 ADHESIVE ANCHOR BOLTS

A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING ISOLATION

A. Horizontal Pipe Isolation: All pumped water, pumped condensate and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.

B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Locate isolation hangers as near the overhead support structure as possible.

D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.

F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.

G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.

H. Install cables so they do not bend across edges of adjacent equipment or building structure.

I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

L. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 21 05 48.13

SECTION 21 11 13 - FIRE SUPPRESSION SYTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.

C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

D. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

E. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT

F. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. Contractor shall include within his bid all materials and Work to provide standpipe and 100% sprinkler protection for all areas in new construction or for the entire smoke compartment affected by renovation work.

D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.

E. Interface all new flow and valve supervisory switches with building fire and smoke alarm systems.

F. Provide temporary fire protection during the construction phase of Project. Inform and obtain approval from the Owner and General Contractor for any interruptions of existing fire protection, domestic water or fire alarm systems. Adhere to ADM1131 Facilities Planned Utility Outages Policy for outage and shutdown requests.

G. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.3 WORK INCLUDED

A. Code compliance, research, design coordination, and installation or a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and sate regulations, and these specifications.

B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.

C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.

D. All permits and approvals of the fire protection system.

1.4 SYSTEMS

A. Systems to be provided under the Fire Protection design section shall be as listed below. The connection point to the site utility service for the fire protection system shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.

1. Pipes, fittings, and specialties
2. Standpipe systems
3. Automatic Sprinkler Systems
4. Combination Standpipe/Automatic Sprinkler Risers
5. Pre-action Sprinkler Systems
6. Fire Department Valve Cabinets
7. ESFR Sprinkler Systems

1.5 GUARANTEE

A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.1 DESIGN STANDARDS

A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:

1. The International Fire Prevention Code
2. The International Building Code
3. National Fire Protection Association (NFPA) Standards:
    a. NFPA 101 - Life Safety Code
    b. NFPA 13 - Installation of Sprinkler Systems
    c. NFPA 14 - Installation of Standpipe and Hose Systems
    d. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems

B. Factory Mutual (FM) Approval Guide

C. Underwriters Laboratories Inc. (UL)

D. Owner's Insurance Underwriter Requirements

1.2 SYSTEM DESCRIPTIONS

A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

B. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

C. Automatic Wet-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

D. Combination Standpipe/Automatic Sprinkler Risers:
1. Combined standpipe/sprinkler risers or Class I standpipe risers with fire department valves shall be installed in each stairwell within the facility. Automatic sprinkler connections will be supplied from combined standpipe/sprinkler risers with a floor control valve assembly at the required locations. Additional standpipes with 2-½" fire department valves are to be provided at required locations throughout the facility per the requirements of NFPA 14.
2. Standpipes will be designed to provide a minimum of 500 gpm. Fire mains supplying standpipes will be hydraulically designed and sized to provide a minimum of 500 gpm at the most remote standpipe and 250 gpm for each additional standpipe to a maximum of 1,000 gpm.
3. A two-outlet roof manifold complete with fire department valves, caps and chains, automatic ball drip, and isolation valve in a heated space shall be provided at the roof area adjacent to the roof access point.
4. The fire protection system shall provide 100 psi at the most remote fire department connection; 65 psi may be allowed as a deductive alternate where acceptable to the local authorities and all applicable Owner design criteria.
5. Standpipes and/or sprinkler connections that are equipped with pressure regulating valves shall be provided with 3" drain risers.

E. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

F. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

G. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.

H. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.

I. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 **and ASCE/SEI 7.**

1.3 DESIGN CRITERIA

A. Any design documents issued to the contractor are for information only. The Contractor shall be responsible for all code research and obtaining all required flow test data and hydraulically designing a fire protection system that meets all applicable requirements. The Contractor shall arrange for, and conduct a flow test and coordinate its validity with the Authorities Having Jurisdiction.

B. Upon award of the Contract, a new flow test from the two (2) hydrants nearest the site service entry is to be performed by the Contractor to confirm the flow and pressure characteristics of the existing water service. The completed flow test data along with a utility service map of the area is to be forwarded to the Engineer for confirmation of the existing water service.

C. Where pre-design of the sprinkler system is required for submission for the building permit: The Fire Protection documents were prepared to be in compliance with all applicable codes and flow test data provided. The Contractor shall review all documents provided and report any modifications required to these documents to the Design Engineer during the shop drawing preparation stage.

D. All sprinkler heads in occupied areas are to be fast response type heads (155 degrees – 165 degrees Fahrenheit).

E. All occupied, heated spaces will be protected by wet sprinkler systems.

F. Inspector test valves will be protected by wet sprinkler systems.

G. Automatic sprinkler systems shall be designed to the available domestic water pressure available and shall be hydraulically calculated for the following design standards:
   1. NFPA 13 Systems

Area/ Usage	Hazard Classification	Density GPM/Sq. Ft.	Remote Area	Maximum Head Spacing	Interior Hose Stream
Public Spaces, Lobbies, Corridors, Offices, Restaurants, Lounges, Meeting Rooms	Light	.10	1,500 sq. ft.	130-200 sq.ft.	100 gpm
Dry Pipe System:	Light	.09	1,950 sq. ft.	130-200 sq.ft.	100 gpm
Mechanical Rooms, Electrical Rooms, Elevator Equipment Rooms, Maintenance/ Storage Rooms, Kitchen/ Food Service Areas and Laundry	Ordinary Group 1	.15	1,500 sq. ft.	130 sq. ft.	250 gpm
Dry Pipe System: Parking Garages, Non-heated Attic Spaces, Ceiling Spaces, Porte Cochere and other spaces containing sprinkler piping that do not have alternate provisions to guarantee a 40° F temperature.	Ordinary Group 1	.14	1,950 sq. ft.	130 sq. ft.	250 gpm
Ballrooms, exterior loading docks, distilleries, barns and stables, dry cleaners, libraries, machine rooms, and auto repair shops.	Ordinary Group 2	.20	1,500 sq. ft.	130 sq. ft.	250 gpm
Dry Pipe System:	Ordinary Group 2	.19	1,950 sq. ft.	130 sq. ft.	250 gpm
Upholstery shops, sawmills, plywood manufacturers, or textile factories, Low-pilled storage, dust or lint generated areas, palletized, bin box, shelf, rack, back to back shelf storage of cartooned group A, storage of tissue and lightweight rolled paper.	Extra Hazard Group 1	.30	2,500 sq. ft.	90-130 sq. ft.	500 gpm
Plastic manufacturing operations, steel manufacturing, and automobile paint spray booths, Space with high combustible or flammable liquids, palletized, bin box, shelf, rack, back to back shelf storage of cartooned group A, storage of tissue and lightweight rolled paper	Extra Hazard Group 2	.40	2,500 sq. ft.	90-130 sq. ft.	500 gpm

H. Available fire-hydrant flow test records indicate the following conditions:
1. Date: UNKNOWN
2. Time: UNKNOWN
3. Performed by: UNKNOWN of Apex Fire Protection
4. Location of Residual fire Hydrant R: 7th Street and El Olam Street
5. Location of Flow fire Hydrant R: 6th Street and Main Street
6. Static Pressure at Residual Fire Hydrant R: 50 psig
7. Measured Flow at Flow Fire Hydrant F: 648 gpm
8. Residual Pressure at Residual Fire Hydrant R: 37 psig

I. The fire protection system design shall include a minimum of 10 psi safety factor to allow for future losses in the water service pressure characteristics. The fire protection systems shall not be designed to operate if the residual pressure of the existing water service falls to 20 psi or lower at design flow requirements.

J. The maximum allowable system velocities shall not exceed 20 fps unless alternate criteria are required by the Owner's Insurance Underwriter.

K. Coordination:
1. The Fire Protection Contractor shall review the complete set of project documents and coordinate his work with all other trades involved.
2. Sprinkler head locations shall be coordinated with the architectural reflected ceiling plans. Locations of sidewall heads shall be coordinated with architectural interior elevations.
3. The fire protection piping and head layout shall function in such a manner so as not to interfere with lighting fixtures, air distribution devices, equipment, piping, and ductwork.

L. Sprinkler Systems
1. Any design documents issued to the Contractor are for information only. The Contractor shall be responsible for the actual layouts, general routing of piping and additional sprinkler heads to meet all requirements.

M. All underground mains and appurtenances are to be installed according to NFPA 24.

N. Combination Standpipe/Automatic Sprinkler Risers

1. Combined standpipe/sprinkler risers or Class I standpipe risers with fire department valves shall be installed in each stairwell within the facility. Automatic sprinkler connections will be supplied from combined standpipe/sprinkler risers with a floor control valve assembly at the required locations. Additional standpipes with 2-½" fire department valves are to be provided at required locations throughout the facility per the requirements of NFPA 14.
2. Standpipes will be designed to provide a minimum of 500 gpm. Fire mains supplying standpipes will be hydraulically designed and sized to provide a minimum of 500 gpm at the most remote standpipe and 250 gpm for each additional standpipe to a maximum of 1,000 gpm.
3. A two-outlet roof manifold complete with fire department valves, caps and chains, automatic ball drip, and isolation valve in a heated space shall be provided at the roof area adjacent to the roof access point.
4. The fire protection system shall provide 100 psi at the most remote fire department connection; 65 psi may be allowed as a deductive alternate where acceptable to the local authorities and all applicable Owner design criteria.
5. Standpipes and/or sprinkler connections that are equipped with pressure regulating valves shall be provided with 3" drain risers.

O. Fire Protection System Alarms

1. The fire protection contractor shall coordinate location and function of all flow, air pressure, supervisory switches, and other dry contacts with the fire alarm contractor.
2. All control valves in the fire protection system shall be provided with supervisory switches wired for annunciation at the main FACP.
3. Automatic sprinkler system connections shall be provided with flow switches adjacent to the zone control valve wired for annunciation at the main FACP.
4. Upright automatic sprinklers will be provided in all elevator shafts and elevator machine rooms. The service to each of these spaces shall be provided with an individual control valve with a supervisory switch and a flow switch located in an adjacent room and wired for annunciation at the main Fire Alarm Control Panel (FACP).

1.4 EQUIPMENT, MATERIALS, BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.

D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.5 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building

modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.6 PRECONSTRUCTION CONFERENCE

A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.7 SUBMITTALS

A. It is the responsibility of the Contractor to coordinate the design with the work of all other disciplines so as to avoid conflicts. Where necessary piping shall be offset around ducts, structural members or other obstructions, while maintaining effective coverage, drains shall be provided per NFPA requirements.

B. Review of the Drawings and hydraulic calculations by PBK is for coordination with the design concept for the project, and for assurance that they have been prepared in a timely manner. PBK is entitled to rely on the technical sufficiency and timely delivery of these documents, as well as on the computations performed by the subcontractor. PBK shall not be required to review or verify those computations or designs for compliance with applicable laws, statutes, ordinances, building codes, and rules and regulations.

C. Fire Protection shop drawings shall include all data required by NFPA Section 13. Shop drawing plans shall indicate all lights, grilles, soffits, alarms, speakers and other ceiling components, as well as hydraulic node points, to ensure coordination. The Contractor shall submit shop drawings to and secure approval of the Owner's Underwriter, local authority and/or state authorities prior to submission to the Engineer. The Contractor shall not commence work, purchase, or provide any materials to the job site without obtaining shop drawing approval. Shop drawings shall include copies of all hydraulic calculations providing design densities, where applicable. In addition, shop drawings submittals shall include printed catalog specifications and data sheets for all of the following as applicable:

1. Fire department valves
2. Sprinkler heads and accessories
3. Siamese Fire Department connection
4. Fire valve cabinets
5. Test header
6. Roof manifold
7. Backflow preventer
8. Cutting oil indicating compatibility with the CPVC sprinkler piping

D. A letter signed by an officer of the Contractor's company shall be included in the submittal book that states the following items meet or exceed the requirements of the specifications:

1. Pipe and fittings
2. Valves
3. Pipe supports
4. Pipe accessories
5. Pipe labels and valve tags
6. Flow switches
7. Tamper switches

E. All required submittal data other than fire protection shop drawings shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.

F. The Contractor shall not proceed with any work without final approved submittal data bearing all approval stamps.

G. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.

H. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.8 SPARE EQUIPMENT

A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
   1. Facilities with less than 300 sprinklers – 6 minimum
   2. Facilities with 300 to 1000 sprinklers – 12 minimum
   3. Facilities with over 1000 sprinklers – 24 minimum

PART 2 - PRODUCTS

2.1 GENERAL

A. All sprinkler system equipment is to be UL Listed or FM Approved.

B. Manufacturers.
   1. Pipe.
      a. Wheatland Tube
      b. Youngstown Tube Company
      c. Bull Moose Tube
      d. Paragon
   2. Sprinkler and Alarm Valve.
      a. Viking Corp
      b. Globe Fire Sprinkler Corp
      c. Tyco
      d. Reliable
      e. Victaulic Company
   3. Valve
      a. Milwaukee
      b. NIBCO
      c. Bray
      d. Mueller Co
      e. Tyco Fire
      f. Victaulic Company
      g. Crane
   4. Specialty Valve
      a. Potter-Roemer
      b. Croker
      c. Guardian Fire Equipment
      d. Elkhart Brass Mfg
      e. Tyco Fire

C. All piping, materials and equipment used in the installation of sprinkler and standpipe systems shall be new and listed as approved by the Underwriters' Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials and the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard and shall be the latest design of the manufacturer.

D. Pressure ratings of pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the designed system pressures in which they are installed.

E. The installing Contractor shall identify piping, fire department connections, valves and hydraulic design information in accordance with applicable NFPA Standards.

2.2 MATERIALS

A. All piping shall be made in the USA and be labeled according to City and /or State manufacturers. Pipe shall be protected with MIC shield coating.

B. All materials, pipe, valves and equipment furnished under this section shall be new and approved by NFPA, Underwriters Laboratories Inc. (UL), Factory Mutual (FM) and American Water Works Association (AWWA) where applicable.

C. Pipe and Fittings:
1. Piping – Schedule 40 ASTM A-53, A-795, A-135, black steel piping for branches (1 inch – 2 inches) and schedule 40 ASTM A-53, A-795, A-135 (2-1/2 inches – 8 inches) black steel for mains.
   a. Piping (piping only, excluding fittings) for dry systems shall be Schedule 40 ASTM 53 galvanized steel in all pipe sizes, screwed galvanized cast or malleable iron fittings through 2", grooved couplings for 2-1/2" and larger pipe sizes.
   b. Buried Water Service Entrance Piping.
      1) Pipe - Cement mortar lined ductile iron.
      2) Fittings – Cement mortar lined ductile iron using mechanical joints.
      3) Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.
      4) All pipe and fittings shall be encased with polyethylene film having a minimum thickness of 8 mils.
2. Fittings under 2-1/2 inches screwed cast iron, 175-pound S.W.P., 2-1/2 inches and larger, flanged, or grooved pipe and fittings to accept a bolted type clamp with gasket.
3. Grooved Couplings & Fittings: ductile iron with gasket and two bolts, 300 psi working pressure. Victaulic, Firelock fittings.
4. Flanges – cast iron, 175 pound S.W.P., with threaded inlet, or Victaulic Mod. #741.
5. Hangers to meet NFPA 13 spacing and type.

D. Control Valves: All control valves are to be electrically supervised. A pressure gauge, water flow switch and test connection with drain shall be provided downstream. The installation shall be per NFPA 13 requirements.
1. 2-1/2 inches and under – 175 psi, Milwaukee "Butterball" with built-in tamper switches.
2. Over 2-1/2 inches – UL listed and FM approved, 175 psi, butterfly valves or OS&Y with tamper switch.
3. All butterfly valves shall have a built in tamper resistant switch for supervision of the open position. The switch shall be contained within a NEMA Type 1, general purpose indoor rated housing. Either unauthorized removal of the switch housing (when the valve is open) or closing the valve, shall cause the

switch contacts to change position. The switch shall have four conductors to accommodate connections to Style 4 or Style 6 signaling line circuit devices.

E. Check Valves:
1. Check valves 2-1/2 inches and larger shall be iron body swing check with cast brass hinge, rod, and brass faced discs.
2. Check valves 2 inches and smaller shall be UL listed brass body and all brass fitted.

F. Alarm Check Valves: Shall be for vertical installation, cast iron, complete with retard chamberport to alarm, pressure gauges, main drain, electric alarm pressure switch with dual contacts suitable for either open or closed circuit.
1. Control valve, check valve, and pressure or flow switch tied to fire alarm system and sprinkler alarm bell.
a. 2-1/2" to 3, Class 150, iron body, bronze disc, flanged or groove ends, TYCO Fire Products LP; AV-1-300, UL Listed for fire service.
b. 4" and larger, Class 150, iron body, bronze trim, flanged ends, TYCO Fire Products LP; AV-1-300, flanged, UL Listed for fire service.

G. Dry Check Valves: Subject to compliance with requirements, provide TYCO Fire Products LP; DPV-1.
1. Standard: UL 260
2. Design: Differential-pressure type
3. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
4. Air Compressor:
a. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include**
b. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
1) Gast Manufacturing Inc.
2) General Air Products, Inc,
3) Viking Corporation.
c. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
d. Motor Horsepower: Fractional.
e. Power: 120-V ac, 60 Hz, single phase.

H. Preaction System:
1. [Double interlock] [single interlock] [non-interlock] pre-action valve and trim to NFPA 13 and UL listed for fire services.
2. Valve and trim assembly to complete with all required valves, alarm line pressure switches, air supervisory switches, valve position supervisory switches, alarms, pressure gauges and alarm test connections.
3. [Air supply system capable of charging the piping system to required pressure within 30 minutes, complete with air compressor, air tank, ball valve and pressure switch] [Connect to building utility air system] to maintain sprinkler system piping pressurization.
4. [Preaction valve and all components preassembled within a lockable steel metal enclosure, red color, pre-wired electrical connections, system control panel and pressure readings visible from front of cabinet, accessible side and back panels].

I. Switches:

1. Water Flow Switches: Shall be paddle type water flow alarm (or pressure switch of retard chamber) and with double contacts for either open or closed circuit operation for connection to building fire alarm system.
2. Tamper Switches: Shall be designed as an integral part of control valve assembly or tamper switch shall have double acting, spring loaded plunger to activate a single-pole double-throw switch for valve supervision of OS&Y type control valves.

J. Fire Department Connections (as indicated on plans):
1. Fire department connection shall be 2-way exposed Siamese type, 2-1/2" x 2-1/2" x 4" size, cast brass body, polished chrome finish for all exposed surfaces, cast brass escutcheon, and brass female hose inlets having individual clapper valves, plugs, and chains. Assembly shall be located with the center line of the hose inlets at 2'-6" above adjacent grade. Inlet threading shall be National Standard or same as municipal fire department, as required. Assembly shall be UL Listed, FM Approved. Wall Mounted: Potter Roemer 5710 series or approved equal.
2. Free Standing: Potter Roemer 5760 series or approved equal.

K. Sprinkler Head Escutcheons.
1. Finish for all escutcheons shall match the finish of sprinkler heads on which they are used. Use white cover plates for white painted soffits and white acoustical ceiling tile, black cover plates for black lay-in acoustical ceiling tile, custom color to match specialty ceilings.

L. Water Motor Gong
1. Provide a water motor gong. No Electric Bell.

M. Fire Valve Cabinet
1. 1810 Series cabinets accommodate a single 2-1/2” (6.4 cm) fire dept valve with cap and chain; 1810-10 Series cabinets accommodate a single 2-1/2” (6.4 cm) fire dept valve, 2-1/2” x 1-1/2” Reducer and 1-1/2” Cap.
2. Cabinet shall be 20-gauge steel with polyester coating, recessed with flush full metal hinged door with cam catch and integral shelf for fire extinguisher. Cabinet shall be Potter-Roemer 1810 series or approved equal.

N. Roof Manifold
1. Wall mount manifold to be three outlet horizontal configuration, cast brass body with threaded 2-1/2" male outlets complete with valves, chains and caps, rough brass finish. Provide accessible indicating type shut off valve with supervisory switch (normally closed) and automatic ball drip to roof. Roof manifold to be Potter-Roemer 5880 series or approved equal.

2.3 STAND PIPES

A. Provide a complete stand pipe system with 2 ½” fire hose connections in compliance with Authority Having Jurisdiction Fire Marshal’s requirements for the entire building with separate stand-pipes at auditorium stage and entrance to the auditorium.
1. Building system shall provide a 2 ½” fire hose connection at each landing of each egress stairwell and additional connections throughout the facility in order to provide complete fire hose coverage based on a 150 foot of hose with 50 foot of water spray. Locate fire hose connections in Fire Marshal and Architect approved locations such as stairwells and mechanical rooms and provide required signage. Contractor shall include stand pipe water flow requirements in hydraulic calculation for sizing of all fire water main piping and fire pump. Contractor shall include in submittal a plan showing location of all fire hose

connections for approval by Authority Having Jurisdiction Fire Marshal prior to fabrication and rough-in. System shall also comply with NFPA 13 for hose connections for fire department use.

2. Provide a complete stand pipe system on each side of the auditorium stage.
3. Provide a complete stand pipe system on each side of the entrance to the auditorium.

2.4 AUTOMATIC SPRINKLER SYSTEM MATERIALS

A. The underground fire protection service shall be provided with thrust blocks and rods and clamps at the service entry.

B. Automatic sprinklers shall be provided as follows:
   1. Public Spaces with Gypsum and Lay-in Ceilings
      a. Fully concealed type sprinklers, glass element, or fusible link style, quick response sprinklers shall be provided in all areas with gypsum ceilings and lay-in ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Ceiling coverplate shall be factory painted to match the adjacent ceiling color; submit painted sample to the Architect for approval. Sprinkler to be Tyco, Reliable, Victaulic or Viking Horizon Mirage concealed sprinkler or approved equal.
   2. Back-of-House Spaces and Unfinished Spaces with no Ceiling
      a. Quick response upright pendent sprinklers shall be provided in all areas with no ceiling. Temperature rating is to be 165 degrees unless conditions require higher temperature. Finish of sprinkler to be rough brass. Sprinkler to be Tyco, Reliable or Viking Microfast Model M.
   3. Kitchen Coolers and Freezers
      a. Standard response semi-recessed chrome plated dry pendent sprinklers with sprinkler guards will be provided in all coolers and freezers. Barrel length shall be a minimum of 12" from the base of the tee to the top of the freezer. Sprinkler and escutcheon shall be polished chrome finish. Sprinkler shall be Tyco, Reliable or Viking Model M.
   4. Pool areas
      a. All sprinkler heads in pool areas, pool equipment room, sanitized room and acid room shall be US Listed/FM Approved quick-response Stainless Steel heads (155 degrees Fahrenheit). Heads must be wax coated. Viking VK338 and VK339 or equal
   5. Exterior Overhangs and Elevator Shafts
      a. Standard response chrome plated dry horizontal sidewall or upright sprinklers are to be provided. Barrel length shall be a minimum of 12". Sprinkler and escutcheon shall have UL Listed polyester or Teflon corrosion protection at exterior overhangs and rough brass finish at elevator shafts. Sprinkler shall be Viking Model M.

C. All outdoor sprinkler heads shall be wax coated.

D. Alternate acceptable manufacturers with equivalent sprinklers are Automatic, Central, Anvil International, Gem and Reliable.

E. Sprinkler guards shall be installed on all sprinklers 7'-0" or less above floor.

F. Provide sprinklers at the highest and lowest level of all stairwells.

G. Provide sidewall sprinklers at the top end and bottom of all elevator hoistways. Sprinklers may be omitted from traction elevators on non-combustible elevator shafts

and cabs which meet the requirements of ASME A.17.1 and where acceptable to the local authorities.

H. Provide sprinklers in electrical rooms and elevator machine rooms unless specifically prohibited by local authorities; the sprinkler supply to each space shall be provided with a supervised valve and flow switch. Coordinate the intermediate temperature rating of the sprinkler head in all elevator machine rooms with the electrical contractor to ensure sprinkler operation will not occur prior to activation of the heat detector and the shunt trip circuit breaker.

I. Sidewall sprinklers shall be installed in all electrical rooms, electrical closets and elevator machine rooms where adequate coverage is provided. Upright sprinklers shall be installed in these spaces when coverage limitations of the sidewall sprinklers are exceeded. Piping shall not be installed above any electrical equipment, switchboard or panelboard. Piping shall offset around surface mounted light fixtures where possible, provide a minimum of 6" clearance below the bottom of the light fixtures at all locations.

J. The property is to be fully sprinklered throughout per the requirements of NFPA unless specifically noted otherwise. Elimination of sprinklers in electrical rooms, elevator shafts and elevator machine rooms shall be clearly indicated on the shop drawing submittal noting the exception applied for the deletion of sprinklers in these spaces.

K. The Contractor shall provide and place suitable signs indicating the purpose of each control valve, test connection, main and auxiliary drain, etc., as required.

L. Provide higher intermediate temperature rated sprinklers in all areas required due to service conditions and as required by NFPA 13.

M. Provide sprinkler connections to all required food service hood suppression systems.

N. Sprinkler guards shall be installed on all sprinklers located in cafeteria and the gym.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.

B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.

C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.

D. All equipment and materials shall be installed according to manufacturer's recommendations and shall meet the requirements of NFPA and the Owner's Insurance Underwriter.

E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.

F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles. For every sprinkler head, tap main/branch pipe serving each individual sprinkler head shall come from the top of pipe to prevent trash from collecting at head. (**Piping laterals to a sprinkler head is FORBIDDEN off the bottom of the main or lateral piping system**).

G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.

H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.

I. **Systems subject to freezing shall utilize anti-freeze liquid. No dry pipe systems.**

J. Provide a pressure gauge at the top level of all standpipes.

K. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.

L. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24" above any finished ceiling.

M. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.

N. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, gymnasium areas, storage rooms and all unfinished areas where the head is less than 7 feet-0 inches above finished floor.

O. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.

P. Building shall be 100 percent fully sprinklered.

Q. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.

R. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.

S. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5” and 2.5” fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.

T. Maintain a minimum 3’ horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.

U. If a deluge system in required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 CLEANING

A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.

B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.

C. Remove all trash and debris from site and dispose of legally.

D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.4 TESTS

A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the “Contractor’s Materials and Test Certificate” shall be submitted to the Architect.

B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.

C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.

D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.

E. Prior to final acceptance by the Owner, submit the “Contractor’s Material and Test Certificates” indicating system compliance with all applicable sections of NFPA.

F. Discharge all test and auxillary drains inside the Fire Riser room and Pump room. No exterior building discharge.

END OF SECTION 21 11 13

SECTION 21 30 00 – FIRE PUMP AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.

C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

D. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

E. SECTION 21 11 13 – FIRE SUPRESSION SYSTEMS.

F. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.

1.3 WORK INCLUDED

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

D. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.

E. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.

F. All permits and approvals of the fire protection system.

1.4 SYSTEMS

A. Systems to be provided under the Fire Protection design section shall be as listed below. The connection point to the site utility service for the fire protection system shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.

1. **Split-case** fire pump.
2. Fire pump accessories and specialties.
3. Flowmeter systems.
4. Pressure Booster (Jockey) pump.
5. Electric Fire Pump Controller.
6. Fire Water Storage Tank.

1.5 QUALIFICATION OF CONTRACTORS

A. The Contractor for the fire protection installation shall be a certified fire protection contractor, licensed for the installation of automatic fire sprinkler systems and other fire protection equipment.

B. An approved contractor for the work under this division shall be:
1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

1.6 GUARANTEE

A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.7 DESIGN STANDARDS

A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:

1. The International Fire Prevention Code
2. The International Building Code
3. National Fire Protection Association (NFPA) Standards:
   a. NFPA 101 - Life Safety Code
   b. NFPA 13 - Installation of Sprinkler Systems
   c. NFPA 14 - Installation of Standpipe and Hose Systems
   d. NFPA 20 - Installation of Centrifugal Fire Pumps
   e. NFPA 24 - Installation of Private Fire Service Mains

f. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems

B. Factory Mutual (FM) Approval Guide

C. Underwriters Laboratories Inc. (UL)

D. Owner's Insurance Underwriter Requirements

1.8 ORDINANCES, PERMITS AND DRAWING APPROVALS

A. The Contractor shall file all requisite plans relating to this section of the specifications with the proper authorities, secure all permits and approvals and pay all resultant fees for work done under this section.

B. All fire protection work shall comply with all laws, ordinances, rules, regulations and standards of the City, County, State and the Owner's Insurance Underwriter; all applicable sections of the National Fire Codes and the Codes and Standards of the National Fire Protection Association.

C. If code or other requirements exceed the provisions shown on the Contract Documents, the Architect shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.9 EQUIPMENT, MATERIALS, BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.

D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.10 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials,

they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.11 PRECONSTRUCTION CONFERENCE

A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.12 SUBMITTALS

A. It is the responsibility of the Contractor to coordinate the design with the work of all other disciplines so as to avoid conflicts. Where necessary piping shall be offset around ducts, structural members or other obstructions, while maintaining effective coverage, drains shall be provided per NFPA requirements.

B. All required submittal data other than fire protection shop drawings shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.

C. Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each fire pump, from manufacturer.

E. Source quality-control reports.

F. Field quality-control reports.

G. The Contractor shall not proceed with any work without final approved submittal data bearing all approval stamps.

H. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

PART 2 - PRODUCTS

2.1 GENERAL

A. Description: Factory-assembled and -tested fire-pump and driver unit.

B. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.

C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

D. All piping, materials and equipment used in the installation of sprinkler and standpipe systems shall be new and listed as approved by the Underwriters' Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials and the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard and shall be the latest design of the manufacturer.

E. Pressure ratings of pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the designed system pressures in which they are installed.

F. The installing Contractor shall identify piping, fire department connections, valves and hydraulic design information in accordance with applicable NFPA Standards.

2.2 FIRE PUMP

A. Electric motor driven fire pump with jockey pump and electric controllers.

B. The fire pumps shall be designed to deliver the capacity necessary to comply with NFPA 13 and NFPA 20 and to provide a complete, code compliant pumped fire protection system. Fire pumps shall furnish not less than 150 percent of rated capacity at not less than 65 percent of total rated head. The shutoff head shall not exceed 120 percent of total rated head.

C. Manufacturers:

1. Armstrong
2. Aurora
3. Peerless
4. Fairbanks-Morse
5. Patterson Fire Pump

D. Vertical Base Mounted Pumps:
1. Type: UL 448 vertical shaft, single stage, double suction, direct connected, split casing for 250 psig maximum working pressure.
2. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Bearings: Grease lubricated ball bearings, replaceable without opening casing.
5. Shaft and sleeve: Alloy steel with replaceable bronze shaft sleeve.
    a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
    b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
    c. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 230 degrees F maximum continuous operating temperature.

6. Drive: Flexible coupling with coupling guard.
7. Baseplate: Cast iron with integral drain rim.
8. Mounting: Pump and driver shafts are vertical, with motor above pump and pump on base

E. Horizontal Base Mounted Pumps:
1. Type: UL 448 horizontal shaft, single stage, double suction, direct connected, horizontally split casing for 250 psig maximum working pressure.
2. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Bearings: Grease lubricated ball bearings, replaceable without opening casing.
5. Shaft and sleeve: Alloy steel with replaceable bronze shaft sleeve.
   a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
   b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
   c. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 230 degrees F maximum continuous operating temperature.
6. Drive: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
7. Baseplate: Cast iron with integral drain rim.

F. Electric Motor Drive
1. Motor: Standard UL 1004A, squirrel cage induction type; in open drip proof NEMA MG-1 enclosure, 1750 rpm.
2. Electrical Characteristics:
   a. Volts: [**460**]
   b. Phase: Three.
   c. Hertz: 60

2.3 FIRE PUMP ACCESSORIES AND SPECIALTIES

A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.

B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.

C. Relief Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   a. BERMAD Control Valves.
   b. CLA-VAL Automatic Control Valves.
   c. Kunkle Valve; a part of Tyco International Ltd. .(For Diesel Fire Pump)
   d. OCV Control Valves.
   e. Watts Regulator Company; a division of Watts Water Technologies, Inc.
2. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.

D. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.

E. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.

F. Hose Valve Manifold Assembly:
1. Standard: Comply with requirements in NFPA 20 and NFPA 25.

2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
4. Automatic Drain Valve: UL 1726.
5. Manifold:
   a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
   b. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
   c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
   d. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
   e. Escutcheon Plate: Brass or bronze; rectangular.
   f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
   g. Exposed Parts Finish: [**Polished**]
   h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST.

6. Manifold:
   a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
   b. Body: Exposed type, brass, with number of outlets required by NFPA 20.
   c. Escutcheon Plate: Brass or bronze; round.
   d. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
   e. Exposed Parts Finish: [Polished] [Rough] [brass] [, chrome plated].
   f. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

2.4 FLOWMETER SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   1. Emerson Process Management; Rosemount Division.
   2. Fire Research Corp.
   3. Gerand Engineering Co.
   4. Hydro Flow Products, Inc.
   5. Hyspan Precision Products, Inc.
   6. Meriam Process Technologies.
   7. Preso Meters; Division of Racine Federated Inc.
   8. Reddy-Buffaloes Pump Company.
   9. Victaulic Company.

B. Description: UL-listed or FM-Approved, fire-pump flowmeter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.

C. Pressure Rating: [**250 psig (1725 kPa)**].

D. Sensor: Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.

E. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter. Include bracket or device for wall mounting.

1. Tubing Package: NPS 1/8 or NPS 1/4 (DN 6 or DN 10) [**soft copper**] tubing with copper or brass fittings and valves.

F. Portable Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter and with two 12-foot- (3.7-m-) long hoses in carrying case.

2.5 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink and recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 PRESSURE BOOSTER (JOCKEY) PUMP

A. Electrically operated, horizontal close-coupled type with standard open drip-proof horizontal motor.

B. Each pump shall be multistage bronze fitted turbine type with bronze impeller, stainless steel shaft, and grease-lubricated ball bearings, similar and approved equal to Aurora Series 11 0.

C. The fire system jockey pump shall be furnished with a factory-mounted bypass relief valve complete with piping. Set relief pressure above the design total dynamic head as required to prevent motor overload and damage to the system.

D. Control by automatic jockey pump controller with full voltage starter and minimum run timer to start pump on pressure drop in system and stay in operation for minimum period of time. Fire pump shall start automatically on further pressure drop or on jockey pump failure.

E. The jockey pump control panel enclosure shall be NEMA 3R wall-mounted, factory assembled, wired, and tested and shall be finished with a baked enamel coating. Panel shall include at least the following equipment:
1. One non-fused disconnect switch mounted on panel door.
2. One combination magnetic motor controller.
3. One hand-off-automatic selector switch mounted on panel door.
4. 120 volt control power transformer and fused disconnect switch as required to operate switches and controls in the panel.

F. The jockey pump controller shall be manufactured by Metron, Firetrol, Sylvania/Clark or Master.

2.7 ELECTRIC FIRE PUMP CONTROLLER

A. The electric fire pump controller shall be manufactured by Metron, Firetrol, Sylvania/Clark or Master.

B. The fire pump controller shall be UL/FM approved for automatic and manual start [and UL Labeled for service entrance]. Controller shall have a NEMA 2 [or 3R] enclosure, 100,000 AIC circuit breaker, disconnect, [wye-delta closed transition] starter, [automatic

transfer switch,] pressure control, minimum run timer, pilot light, start-stop push buttons, manual operator, alarm relays, [sequence start timer,] phase reversal monitor, alarm bell and lights, fused power control transformer, and remote annunciator all as required by and in accordance with NFPA 20 and Electric Code, NFPA 70 and include the following:

1. The locked rotor overcurrent protection shall be provided by a separate overcurrent monitor of the microprocessor type, set at 300 percent of motor full load current and shall have a trip time between 8 and 20 seconds at 600 percent of motor full load current.
2. Isolation switch with single external operating handle interlocked with circuit breaker. Operating mechanism shall be flange or side mounted.
3. Nonfused control power transformer.
4. START and STOP pushbuttons for manual control.
5. Ammeter test links and voltmeter test studs.
6. POWER AVAILABLE pilot light to indicate power on the load side of the circuit breaker and PHASE REVERSAL pilot light for the line side of the motor starter. Pilot lights shall be mounted externally.
7. Surge protector wired to the line side of the isolation system.
8. Solid state pressure switch and transducer with energize to start relay. Pressure switch shall be differential adjustable type with LED indicators for trip and reset. NOTE: Pressure switches in systems exceeding 175 psi shall have a range from 0 to 600 psi.
9. Minimum run time, adjustable 0 - 10 minutes with timed-out LED indicator. Per NFPA 20 and FM pump should be arranged for “manual stop” the run-timer and auto stop function must be disabled.
10. Magnetic contactors with externally operable mechanical start mechanism.
11. Two sets each of dry form "C" contacts for remote indication of PUMP RUNNING, POWER FAILURE and PHASE REVERSAL.
12. The electric fire pump controller shall also include an automatic start relay of the drop-out type, and a local built-in alarm panel powered from a separate reliable 120 VAC power source.
13. The local alarm panel shall have individual indicating lights with a common alarm bell and silence button for POWER FAILURE, PUMP RUNNING, PHASE REVERSAL, LOW DISCHARGE PRESSURE, TRANSFER SWITCH IN EMERGENCY, ISOLATION SWITCH OPEN and REMOTE START.
14. A local indicating light and two sets of remote alarm contacts shall be furnished to monitor SUPERVISORY POWER of the local alarm panel.
15. Two sets of dry form "C" remote alarm contacts shall be provided for LOW DISCHARGE PRESSURE, TRANSFER SWITCH IN EMERGENCY and ISOLATION SWITCH OPEN.
16. A separate pressure switch shall be supplied to monitor discharge pressure.
17. All indicators shall be illuminated from the rear by long life LED lamps. Incandescent lamps are not acceptable

C. **The fire pump controller shall be factory assembled, wired and tested [with an Automatic Transfer Switch (ATS) listed by Underwriters' Laboratories, Inc. for transfer switch and fire pump controller service,] and shall conform with NFPA 20 and NFPA 70 and be in accordance with [UL 1008 and] UL 508. Ammeter test links and voltmeter test studs shall be provided in the enclosure and a two-position pushbutton marked "START-STOP" and an emergency start handle shall be provided on the enclosure.**

D. **The automatic transfer switch shall be wired to the fire pump controller and mounted in a separate compartment with an isolation barrier. The automatic transfer switch shall include an isolation switch and externally operable handle, voltage and frequency sensitive relays for normal power, voltage and frequency**

sensitive relays for emergency power sensed from emergency control power transformer, normal and emergency control power transformers, and time delays for ENGINE START, TRANSFER TO EMERGENCY, RETRANSFER TO NORMAL and ENGINE COOLDOWN. The transfer switch shall also include provisions for preventing higher than inrush currents when transferring power in either direction, a TEST switch and pilot lights for NORMAL POWER and EMERGENCY POWER.

E. A remote annunciator panel shall be furnished and installed by this Division in the Fire Command Center and shall be wired to the fire pump controller by Division 26. The remote annunciator shall be flush mounted and shall have an audible alarm with silence pushbutton and indicator lights for "Fire Pump Running", "Loss of Main Power", "Phase Reversal", **["Emergency Isolation Switch Off"]** and "Low Discharge Pressure". **The remote alarms shall also have alarm output contacts for monitoring of fire pump trouble and run alarms by the Fire Alarm System specified under Division 28**] **[and the Building Control and Automation System specified under Division 23.**

F. **Manufacturer shall provide power wiring from the pump to the controller, whether it be three, six, etc. wires.**

G. **All fire pump controller [ATS] and remote annunciator control switches and indicators shall have engraved identifying nameplates.**

2.8 FIRE WATER STORAGE TANK

A. General: Provide and install new bolted fiberglass break tank at the location shown on the Drawings and mount on a concrete housekeeping pad. Size shall be as indicated on Drawings. Provide, construct, install and test tank(s) in strict accordance with the following codes and standards:
   1. NFPA Pamphlet No. 22-1984, Standard For Water Tanks For Private Fire Protection.
   2. Sanitary requirements of NSF 61.
   3. ASCE 7-05: Minimum design loads for buildings and other structures, AWWA D121-12.
   4. Local AHJ.

B. Tank must be fabricated in ISO 9001:2008 facilities with at a minimum of five years' experience in building 3500 gallon or larger tanks for use in commercial applications. The tank manufacturer shall provide:
   1. A written and notarized certificate, signed by the owner or an officer of the tank manufacturing company, stating that the tank has been constructed and tested in strict accordance with these specifications and all requirements of the codes and standards listed above.
   2. A nameplate permanently affixed to the tank permanently indicating the name of the tank manufacturer, date of tank fabrication, and serial number of the tank.

C. Construction:
   1. Material for panel production shall be isophthalic unsaturated polyester resin to conform to ASTM specifications: D368, D695, D790 and D792., and the glass fiber used shall be non-alkali type conforming to ISO 1172.
   2. Manufacturing process of panels shall be a hot press molding system at 300°F temperature and 3000 PSI with curing characteristics conforming to ISO-12114 and shrinkage properties to ISO-2577. The sheet molding compound (S.M.C.) raw material shall be conforming to ISO-10352 and from an approved NSF 61 supplier.

3. SMC forming panels shall be externally reinforced with F/G roving mesh of density not less than 87 oz/ft^2 before the hot pressing process.
4. Panels and covers shall be of grey color in accordance to Munsell's value N-7.0 to prevent light transmission, conforming to ASTM E903-96, in order to avoid algae growth inside the tank. (Value of light transmission shall not exceed 0.00%.)
5. Tolerance on each panel shall be within +/- 0.03% of the nominal dimensions.
6. F.R.P Panels:
   a. Shall be externally flanged at 90° on four sides.
   b. Thickness of flange for roof panels shall not be less that ¼" with a landed with of not less than 2-1/4", other panels flange shall not be less than 13/32" and the landed width of all flanges shall not be less than 3".
7. Sealing Material:
   a. Sealant materials used for joints shall be chemically stable, non-toxic, flexible and resistant to UV rays and must be certified for non-toxicity in accordance with NSF 61.
   b. Material for the main solid sealant shall be made of S.E.B.S. (Stylene Ethylene Butyrene Styrene) i.e. solid synthetic rubber whereas material for the roof sealant shall be made of EPDM rubber.
   c. The main sealant shall be ribbed in not less than 4 locations. These ribs shall be continuous along the length of the sealant without any breaking.
   d. The main sealant shall be certified by NSF 61
8. Reinforcement & Supports of Tank
   a. Tanks to be strengthened externally with hot-dipped galvanized steel conforming to ASTM A123.
   b. Internal reinforcement, if required, to be SS grade A4-316.
   c. Support poles of ceiling panels shall be uPVC pipes or FRP pipe according to tank height & proper structural design.
9. Roof manhole panels shall have a 30" diameter clear opening and access door fixed with SS hinges and locking device.
10. Side manway panel shall have a 30" diameter clear opening sealed with food grade rubber capped SS bolts.
11. External ladder shall be hot dipped galvanized steel and internal ladder shall be made of FRP food grade material conforming to NSF61.
    a. External ladder shall extend no less than 6" above the tank to safely ascend/descend from the tank.
12. Bolts, nuts, and washers for external fixing shall be hot dipped galvanized steel grade 8.8, and stainless steel A4-316 for internal fixing.
13. Bolt sets to be food grade rubber capped type for connecting the flanges of inlet, outlet, overflow, and drainage to water tanks.
14. Anti-vortex plate on each pump suction connection into tank.
15. Each tank compartment shall be equipped with a fiberglass backed, tube type water level indicator. Each indicator must include a drain valve for service.
16. Tank to sit on pedestal up-stand beams at every 3.3Ft. interval to lift the tank by a minimum of 15". Pedestals to be made of four welded 2" angles to make a cross section with welded double walls. Pedestals shall be hot dipped galvanized steel conforming to ASTM A123.

D. There shall be an air space between the walls of the partition of not less than four (4) inches with an opening (not threaded) at the bottom to give visual evidence of leakage of the walls of the partition.

E. Connections:
1. Flanges shall be made of UPVC full face high pressure bolted type with EPDM rubber gasket ribbed in a least two locations. 2.
2. Flanges shall be fixed to the tank panels with hot dipped galvanized, food grade

and UV resistant type rubber capped bolts.

3. Overflow opening shall be at least twice the size of the inlet and shall flow freely to the ground to avoid bottlenecking.

F. Controls:

1. Water Control Valves (Fill Valve): Cla-Val model 136-01(3), solenoid operated diaphragm activated globe valve. Valve to be normally closed, energized-to-open with ductile iron epoxy coated body. Valves shall be equipped with SS trim, closing speed control and integral strainer. Float valves are not acceptable.
2. Block Valves: AT Controls NS series, full lug butterfly valve with electric actuator. Normally open, motor operated valve shall be provided as sized on the plans. The valves to be activated by the high-level signal from the respective tank or tank compartment. Solenoid operated diaphragm valve not acceptable for block valve.
3. Water Level Controls: Provide a complete PLC based control system to monitor various conditions in the fire water and domestic water section of the tank. Panel shall be built by a UL 508A approved control systems manufacturer and 100% tested at the factory prior to shipping. System shall include but not be limited to:
   a. A submersible level transmitter and (3) wire suspended level electrodes installed in a 3” flange polycarbonate sensor assembly, capable of providing adjustment of all level sensors through the housing of the sensor assembly. Provide 1 assembly per each tank compartment.
   b. Minimum Type 4X rated enclosure with lockable latches approved for indoor/outdoor environments.
   c. LED red day light visible, flashing alarm beacon, mounted on the top of the enclosure.
   d. Alarm Buzzer
   e. UL489 single pole main disconnect, 7 amp
   f. Conductivity critical high-level relay
      (1) Redundant relay operation protects against PLC or sensor failure.
   g. Front panel indicators shall include:
      (1) Fill Valve 3-position selector switch, Open-Close-Auto, Green illuminated LED.
         (a) 120vac power to open
         (b) Solenoid operation
      (2) Block Valve 3-position selector switch, Open-Close-Auto, Red illuminated LED.
         (a) 120vac power to close
         (b) 120vac power to open
         (c) L1 and neutral for enclosure heater
         (d) Motor operated valve
      (3) Critical high level alarm, Red LED indicator
      (4) LED backlit digital touchscreen
   h. Touchscreen HMI functions as follows:
      (1) Lead fill valve selection
      (2) Alarm silence button
      (3) “High Level Alarm” indication
      (4) “Low Level Alarm” indication
      (5) Continuous level readout, in inches.
      (6) Level settings
   i. Panel shall be equipped with remote monitoring dry contact for general alarm
   j. A form C dry contract for low level pump cut-off
   k. One set of spare fuses

4. System Function:
   a. Normal Operation:
      (1) The level and alarm control panel shall monitor the level in the domestic/fire water storage tank and automatically open/close the lead fill valve to maintain level. The lead valve shall be automatically alternated after each fill cycle. Should the lead valve be unable to restore the level, the lag vale shall be energized.
   b. High Level Condition:
      (1) Should the level in the tank rise to either the primary or the backup high level alarm level, the high-level alarm shall sound, and the block valve circuit shall be energized, closing the MOV block valve. High-level specific auxiliary contact shall close.
   c. Low Level Condition:
      (1) Should the level in the break tank fall below the Low-Level Alarm set point, the Low-Level Alarm shall sound, and the pump cut-off contact shall open/close to shut down the pumps. Low-level specific auxiliary contact shall close.

5. The control wiring between the level alarm control panel and all system devices (level sensors, fill valves, block valves, etc.) is to be the responsibility of the level alarm control system provider.

G. Additional:

1. Refer to break tank manufacturer requirements for all required install recommendations and guidelines prior to purchase. Contractor shall submit to the Engineer for review the product data required for this equipment installation.

H. Acceptable Manufacturers:
   1. Fiber Technology Corporation with Cougar USA
      a. Contact: Michael Balboni – 832-912-7500
   2. Acceptable alternate: 316 Stainless Steel Tank

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 MANUFACTUERER'S INSTRUCTIONS

A. Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3 INSTALLATION

A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.

B. Install in accordance with ULC listing, ANSI/NFPA 20, manufacturer's instructions and approved shop drawings.

C. Install engine cooling system.

D. Insulate exhaust system, cooling system muffler in accordance with Section 21 05 00 - Thermal Insulation for Piping.

E. Align pump and motor shafts to within manufacturer's recommended clearances prior to start-up.

F. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

G. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings or pump suction and discharge.

H. Flow meter shall discharge into atmospheric suction tank. Flow meter loop shall not circulate back to the pump suction line.

I. Locate fire pump test hose valve header on exterior wall accessible from grade level.

J. Provide piping to, and route discharge from all relief valves and drains to exterior of building and terminate at a location and in a manner to prevent any damage to surrounding areas.

K. Provide full line size bypass with double-check valve assembly around surge tank and fire pump.

L. Coordinate connection to electrical service.

M. Provide a pressure gauge at supply and suction side of fire pump.

3.4 DEMONSTRATION

A. To obtain complete and final acceptance of the fire protection system, all inspections, approvals, examination and acceptance tests required by the Authority Having Jurisdiction shall be arranged and paid for under this Section.

B. Sprinkler Contractor shall provide necessary equipment and test materials for testing of the installation.

C. Testing of the completed sprinkler system for acceptance shall be witnessed by an Owner’s representative. Testing should be coordinated with the Authority Having Jurisdiction.

D. Provide the Owner with as-built drawings and equipment data at completion of construction.

E. Provide completed Underground and Aboveground Contractor’s material and Test Certificates per NFPA 20 at time of acceptance of test.

3.5 WORKMANSHIP

A. All work shall be coordinated with the work to be performed or installed under other sections of these Specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. Offsets shall be provided as required to avoid interference and conflicts with other work, to maximize headroom, or to improve the appearance of pipe runs. All pipe supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.

E. The subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

3.6 INSTRUCTIONS AND START-UP

A. Contractor shall provide for the service of a competent factory-trained supervising agent from the fire pump manufacturer to inspect the completed installation, start the system and acquaint the operators with the proper operation and maintenance of the equipment.

3.7 TESTS

A. Tests of all fire protection systems and equipment, shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the “Contractor’s Materials and Test Certificate” shall be submitted to the Architect.

B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.

C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.

D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.

E. Prior to final acceptance by the Owner, submit the “Contractor’s Material and Test Certificates” indicating system compliance with all applicable sections of NFPA.

3.8 INSTRUCTION OF OWNER'S PERSONNEL

A. See related section 21 05 00.

3.9 OPERATION AND MAINTENANCE MANUALS

A. See related section 21 05 00

END OF SECTION 21 30 00

SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide all work for plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

B. All materials and equipment for the potable water system shall meet the latest amendments, mandates, and requirements for lead free required by law that went into effect January 2014.

C. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc., required and/or necessary to completely install, clean, inspect, adjust, test, balance, and leave in safe and proper operating condition for all systems. All work shall be accomplished by workmen skilled in the various trades involved.

D. Phased Construction:

1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the building(s) and plumbing and fire protection systems that must remain operational.

2. Contractor shall include all temporary services required to keep the Owner-occupied portions of the building(s) operational without interruption of plumbing and fire protection services for the duration of the project.

3. Refer to architectural Drawings for description of phasing, stage all plumbing work and fire protection work accordingly.

E. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawings and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

F. Unless directly specified otherwise, all noted pipe diameters herein are nominal.

1.3 QUALITY ASSURANCE

A. Perform all work in accordance with the latest edition of the applicable codes, Specifications, local ordinances, industry standards, utility company regulations, and nationally accepted codes.

B. All materials, distribution, and utilization equipment shall be UL Listed.

C. All equipment and materials shall be new, unused, of United States domestic manufacture, and comply with the Buy America Act, unless approved otherwise by the Engineer or Owner.

D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer to not be an inherent part of the systems as designed without additional cost to the Owner.

E. An approved Contractor for the work under this Division shall be:

1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.

2. Able to furnish evidence of having contracted for and installed not less than (3) systems of comparable size and type that have served their Owners satisfactorily for not less than (3) years.

1.4 WORK INCLUDED

A. Systems: Plumbing systems installed, and the work performed under this Division of the Specifications, shall include, but are not necessarily limited to, the following systems as noted below. The connection point for all systems from the site utilities shall be at 5’-0” from the exterior of the building unless specifically noted otherwise.

1. Compressed air system

2. Domestic cold water, hot water, hot water recirculation systems

3. Domestic water softening system

4. Fuel oil system

5. Grease waste and waste systems from food service areas

6. Natural gas systems

7. Primary storm drainage, secondary storm drainage systems

8. Propane/air mixture gas systems

9. Sanitary drainage, waste, vent systems

B. Contract quality control including workmanship, manufacturer’s instructions, mock-ups, and demonstrations.

1. Executing Mock-ups:

a. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals, and finishes.

b. Do not proceed with any work involving a mock-up until the related mock-up has been approved in writing.

c. Acceptable mock-ups in place shall be retained in the completed work.

d. Perform tests and submit results as specified.

2. Scheduling Mock-ups: Schedule demonstration and observation of mock-ups, in phases, with Architect/Engineer for:

a. Rough-in

b. Finish with all appurtenances in place

c. Insulation installed

d. Demonstrations

1.5 COMPLETE PERFORMANCE OF WORK

A. All labor, materials, apparatus, and appliances essential to the complete and proper functioning of the systems described and/or indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Drawings and Specifications or not, shall be provided by the Contractor. The entire installation shall be ready in every respect for the satisfactory and efficient operation when completed.

B. Provide all rigging required for complete installation and furnish Drawings showing necessary points of support, reactions, and supplementary bracing. This shall be submitted for approval by the Owner. Should any shoring be required, provide same after Owner's approval.

C. Become thoroughly acquainted with the work involved; obtain and verify at the building all measurements necessary for the proper installation of work. Furnish to other Contractors any information relating to work of this Division necessary for the proper installation of their Contracts. Confer with other Contractors for finish adjacent to work of this Section and arrange to have visible portions of the work (e.g., access doors, grilles, escutcheons, etc.) fit in and harmonize with the finish in a manner satisfactory to the Architect.

D. Transmit to trades doing work of other Sections all information required for work to be provided under their respective Sections (e.g., freshwater connections, foundations, electric wiring, access doors, etc.) in ample time for installation.

E. Where disagreements occur between the Plans and the Specifications, or within either document itself, the item or arrangement of better quality, greater quantity, or higher cost shall be included in the Base Bid.

1.6 COORDINATION WITH OTHER TRADES

A. Coordinate the work of this Division with all other Divisions to ensure that all components of plumbing and fire protection systems will be installed at the proper time and fit the available space.

B. Locate and size all openings in work of other trades required for the proper installation of the plumbing and fire protection systems' components.

C. Make all plumbing and fire protection connections to all equipment furnished by this Division and as required by any other Division.

D. Electrical wiring, control equipment, and motor starters indicated on the electrical Drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the plumbing trades, either in these Specifications or on the plumbing Drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical Drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these Specifications.

E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with plumbing equipment shall have overload protection in all phases. It shall be the responsibility of each Subcontractor furnishing motors and devices to advise electrical

Contractor of exact function of systems to assure proper type of starter with correct number of auxiliary contacts for proper operation of the system.

F. The plumbing trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner because of lack of such coordination.

G. The design of the electrical system(s) is based on the plumbing equipment specified and scheduled on the Drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the plumbing trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.

H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the electrical Contractor at the site for custody, erection in place, and wiring as specified.

I. Smoke detection systems shall be furnished and installed under Division 26. Coordinate locations with electrical Contractor.

J. Contractor shall conform and comply with the plumbing requirements of DIRTT wall system per Division 13.

1.7 DRAWINGS

A. The Drawings are schematic in nature but shows the various components of the system(s) approximately to scale and attempts to indicate how they are to be integrated with other parts of the building. Contractor shall determine exact locations by review of equipment manufacturer's data, jobsite measurements, checking the requirements of other trades, and reviewing all Contract Documents. The size of the plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed and approved manufacturers shall be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The Drawings are not intended to show exact locations of pipes and ducts, nor to indicate all offsets, fittings, and supports, but rather to indicate approximate layout.

B. The mechanical, electrical, plumbing, and fire protection Drawings are necessarily diagrammatic in nature and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances, structural conditions, and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases, suspended ceilings, soffits, finished portions of the building, etc., unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical, electrical, plumbing, and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system(s) involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

D. The locations, arrangement, and extent of equipment, devices, and other appurtenances related to the installation of the work shown on the Drawings are approximate. The Contractor shall not scale Drawings; rather, the Contractor shall refer to the Architect Drawings for exact dimensions of building components. Should a conflict exist between the Architect and Engineer Drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.

E. Materials, equipment, or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. The Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.8 SUBSTITUTIONS

A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in these Specifications and the procedures covered by these Specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. Refer to Division 01 Specification for additional requirements.

B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cutsheets, performance and test data, and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who, in their judgement, is unsuitable for use on the Project and that decision shall be final.

D. **No substitutions will be considered after the Award of Contract.**

E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request, identify the product, fabrication method, or installation method to be replaced by the substitution; include related Specifications Section(s), Drawing(s), and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate with each request, the following information:

1. Product data, drawings, and descriptions of products, fabrication methods, and installation procedures.

2. Samples where applicable or requested.

3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance, and visual effect where applicable.

4. Coordination information, including a list of changes or modifications needed by other parts of the work and construction, to be performed by the Owner and separator Contractors that will become necessary to accommodate the proposed substitution.

5. A statement indicating the effect the substitution will have on the Contractor's construction schedule compared to the schedule without approval of the

substitution. Indicate the effect of the proposed substitution on overall Contract Time.

6. Cost information, including a proposal of the net change, if any, in the Contract Sum.

7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including the Architect and Engineer's redesign and evaluation costs, resulting from the use of the proposed substitution.

9. Conditions: The Contractor's request for substitution will be received and considered when extensive revisions to the Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented, properly submitted, and when one (1) or more of the above conditions are satisfied, then the substitution will be judged and determined by the Architect and Engineer; otherwise, the requests will be returned without action except to record non-compliance with these conditions and requirements.

1.9 SUBMITTALS

A. Provide shop drawings and complete product data as indicated in each Specifications Section.

B. Coordination drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the ductwork and piping as well as the major mechanical, plumbing, and fire protection equipment are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at one-eighth (0.125) inch scale or larger and drawing per building area. Provide one-quarter (0.25) inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.

C. Shop drawings will be reviewed and returned to the Contractor with one of the following categories:

1. **Reviewed:** No further submittal action is required. Submittal shall be included in the Operation and Maintenance (O & M) manual.

2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in the comments section of the Engineer's Submittal Cover Letter.

3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and shall be required to furnish product(s) named in the Specifications and/or Drawings.

4. **Furnish as Corrected:** Contractor to submit letter verifying that the required correction(s) noted on the Engineer's Submittal Cover Letter have been received

and complied with by the manufacturer(s). If equipment onsite is not in compliance with the correction(s) noted, then the Contractor shall be responsible for the cost of removing and replacing the equipment.

D. Materials and equipment which are purchased or installed without submittal review and approval will be removed and replaced with specified equipment at the Contractor's expense.

E. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.

F. All approvals required by any code or enforcement authority, insurance underwriter, etc., shall be obtained prior to equipment being submitted to the Engineer.

G. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to which item.

I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc., of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.10 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 01 – General Requirements and each Specification Section.

1.11 INTERFERENCE DRAWINGS

A. Where field conditions prohibit the installation of the plumbing or fire protection system components within the available space as indicated on the Drawings, the Contractor shall prepare a sketch to the minimum one-eighth (0.125) inch scale clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the Contract Documents without incurring additional cost.

B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.12 EXISTING CONDITIONS

A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these Contract Documents. All demolition work implied or required shall be included in the scope of this contract.

B. Service outages required by the new installation shall only be permitted at a time approved by the Owner. The Contractor shall allow the Owner a two (2) week window to schedule required outages. The time allowed for outages shall not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.

C. Work Sequence, Timing, Coordination with Owner:

1. During the construction of this project, normal facility activities will continue in existing building(s) until the new building(s) or renovated area(s) are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building(s).

D. Demolition and Work Within Existing Building(s):

1. In the preparation of these documents, every effort has been made to show the approximate locations of – and connections to – the existing piping, duct, equipment, and other apparatus related to this phase of the work; however, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the existing facilities and related areas. Prior to the submission of a proposal, the Contractor shall inspect and verify all details and requirements of all the Contract Documents. All discrepancies between the Contract Documents and actual jobsite conditions shall be resolved by the Contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this contract.

2. All equipment and/or systems noted on the Contract Drawings “TO REMAIN” shall be inspected and tested onsite to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions/costs, shall be made by the Contractor to the Architect/Engineer for review.

3. All equipment and/or systems noted on the Contract Drawings “TO BE REMOVED” shall be removed—including associated system connections. Where duct or pipe is to be capped for future extension or end-of-line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an associated electrical connection, the Electrical Contractor shall disconnect equipment and remove wiring back to the panel or disconnect switch. Contractor shall remove or relocate equipment and the associated disconnect.

4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material, tools, extension cords, etc., shall be arranged to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing building(s) or be conducted in a manner causing harm or danger to any person(s) on the premises. All fire exits, stairs, or corridors required for proper access, circulation, or exit shall remain clear of equipment, materials, or debris. The General Contractor shall maintain barricades separating the work area(s) from the occupied area(s).

5. Certain work during the demolition and construction phases of the construction process may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation(s) with the Project Administrator at least seventy-two (72) hours in advance in writing.

6. Any salvageable equipment, as determined by the Owner, shall be delivered to the Owner and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

7. Equipment, piping, or other potential hazards to the occupants of the building shall not be left overnight nor outside of the designated working or construction area(s).

8. The Contractor shall make every effort to minimize damage to the existing building(s) and the Owner's property. Repair, patch, or replace as required any damage which might occur because of work at the jobsite. Care shall be taken to minimize interference with the Owner's activities during construction and to keep the construction-disrupted area(s) to a minimum.

9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of existing equipment and plumbing fixtures as required by the field conditions to allow the installation of the new system(s) regardless of whether such rerouting, reconnecting, or relocating is explicitly shown on the Contract Drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation, and plumbing services for the existing area(s).

10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls, and appurtenances not included in the remodel or alteration area(s) shall remain in place.

11. Pipe, duct, equipment, and controls that are disconnected to perform remodeling work shall be reconnected in such a manner as to leave system(s) in proper operating condition.

12. No portion of the fire protection system(s) shall be turned off, modified, or changed in any way without the express knowledge and written permission of the Owner's representative(s) to protect the system(s) that shall remain in service.

13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with minimized disruption or downtime.

14. Refer to architectural demolition and/or alteration Drawings for actual location(s) of walls, ceilings, etc., being removed and/or altered.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Accept materials onsite in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage by storing in original packaging.

C. Do not deliver items to jobsite before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.14 GENERAL ELECTRIC REQUIREMENTS

A. Provide electric motors, control panels, certain control and safety devices, and control wiring when specified or required for proper operation of electrical systems associated with plumbing equipment specified in Division 22.

B. Electrical materials and work provided shall be in accordance with Division 26.

C. The Contractor shall notify the Architect/Engineer fourteen (14) days in advance in writing before bids are due if it is necessary to adjust the horsepower of any motors or modify any

electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.15 ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

A. Plumbing equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.

B. Unless otherwise specified, the electrical supply being furnished is a 480 volt, 3 phase, 3 wire, 60 hertz source. A neutral connection will not be provided, the manufacturer shall include any transformers for equipment requiring other voltages (277 volt, 120 volt, 24 volt, etc.).

C. During the submittal process, any proposed deviations from the specified equipment in the Contract Documents shall be clearly indicated on the Plumbing submittal(s). Voltages shall match that of the specified equipment in the Contract Documents; however, if the submitted equipment ampacity, horsepower, etc., differs from the specified equipment, then the Contractor shall coordinate any changes required for the submitted equipment's electrical characteristics with the Electrical Contractor at no additional cost to the Owner.

D. Electric Motors:

1. For each piece of equipment requiring electric drive, provide a motor having the starting and running characteristics consistent with the torque and speed requirements of the driven machine.

2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of the driven equipment on the Shop Drawings.

3. Contractor shall verify electrical characteristics of each motor with the Electrical Drawings.

4. Motors which are shipped loose from equipment shall be set by the supplying Subcontractor.

5. Alignment of motors factory-coupled to equipment and motors field-coupled to equipment shall be rechecked by the millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and rechecked again after forty-eight (48) hours of operation in designed service.

6. Where possible, motors shall be factory mounted.

1.16 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes indicating actual, final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of one-eighth (0.125) inch scale.

B. The original set of as-built drawings shall be scanned and transmitted to the Architect/Engineer in both full size bond (print) and Portable Document Format (PDF).

C. As-Built drawings: Two (2) sets are for the Owner's use and one (1) set is for the Architect/Engineer's records. Delivery of these as-built prints and reproducibility is a

condition of final acceptance. Provide as-built drawings of one (1) set each of PDF and AutoCAD 2015 files on a compact disc (CD).

1. Number of Copies: Submit one (1) set of marked-up as-built prints.

2. Number of Copies: Submit copies of as-built drawings.

    a. Initial Submittal:

        1) Submit PDF of scanned as-built prints and one (1) set of the prints itself.

        2) Submit as-built AutoCAD digital files and one (1) set of the files plotted in PDF.

        3) Architect will indicate whether general scope of changes, additional information record, and quality of drafting are acceptable.

    b. Final Submittal:

        1) Submit PDF of scanned as-built prints and three (3) sets of prints itself.

        2) Submit as-built AutoCAD digital files and three (3) sets of the files plotted in PDF.

        3) Plot each drawing file whether changes and additional information were recorded.

D. As-built drawings should indicate the following information at a minimum:

1. Indicate all addendum changes to the Contract Documents.

2. Remove Engineer’s seal, name, address, and logo from the drawings.

3. Mark and indicate these are “AS-BUILT DRAWINGS” on the documents.

4. Mark and indicate “DOCUMENT PRODUCED BY” followed with the responsible Contractor’s relevant information.

5. Indicate all changes to construction during the construction process.

6. Indicate actual routing of all piping, ductwork, etc., that deviated from the Contract Documents.

7. Indicate exact locations of all below grade plumbing piping and their respective flow line elevations.

8. Correct equipment schedules to reflect actual equipment furnished and their respective manufacturer, make, and model.

9. During the execution of work, maintain a complete set of drawings and specifications where all locations of equipment, ductwork, piping, devices, and all deviations and changes from the Contract Documents in the work shall be recorded.

10. Location and size of all plumbing piping above ceiling—including exact locations of valves.

11. Indicate exact locations of all fire protection sprinkler heads and zone valves in the system.

12. Indicate exact locations of all roof-mounted equipment, wall, roof, and floor penetrations.

13. Indicate all changes with clouding around said changes.

1.17 STARTUP SERVICE

A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and startup of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report shall be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the Owner's personnel shall be provided following certification of the assembly.

1.18 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades and shall furnish all information necessary to permit the work of all other trades to be installed satisfactorily and with the least possible interference or delay.

B. Piping, fixtures, and plumbing equipment shall not be installed without first coordinating the installation of it with other trades. The Contractor, at their own expense, shall relocate all piping, fixtures, and plumbing equipment installed without coordination should the plumbing elements interfere with the proper installation and mounting of electrical elements, mechanical elements, technology elements, ceilings, architectural elements, and structural elements.

C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other trades and disciplines prior to installation.

D. In areas where more than one trade is required to utilize common openings in structural beams, joists, chases, shafts, and sleeves for the passage of conduits, raceways, piping, ductwork, and other materials, the Contractor shall coordinate the positions of all piping and plumbing equipment to be furnished under this Division so that all items, including the materials and equipment of other trades and disciplines, may be accommodated within the space available.

E. The Contractor shall confirm that work installed under this Division does not interfere with the clearances required for finished columns, pilasters, partitions, walls, or other architectural and structural elements as shown on the Contract Documents.

F. Work that is installed under this contract and interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract Documents.

G. The Contractor shall examine the entire set of Contract Documents and carefully investigate the structural and architectural finish conditions affecting all their work and shall arrange such work accordingly for the complete and satisfactory operation of all systems. The Contractor shall provide all offsets, fittings, valves, devices, and accessories that may be required to meet such conditions.

1.19 WARRANTY

A. All equipment furnished and installed under this Division shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. To "make good all defects" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All equipment, materials, accessories, etc. necessary for the work required shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the manufacturer-intended use and shall be subject to approval by the Engineer.

B. All equipment, products, and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection label of Underwriters Laboratories.

D. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

E. Cast iron waste piping and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.2 ACCESS PANELS

A. Acceptable manufacturers:

1. Precision Plumbing Products
2. MIFAB
3. Acudor
4. Elmdor
5. Milcor

B. Group valves together above suspending ceilings, walls, furred spaces, etc. to minimize the number of access panels required, but with all valves freely accessible for easy maintenance and inspection. Locate all valves within 1'-0" of the access panel entry point. Minimum size requirements shall be:

1. 18" X 18" for electrical-related items
2. 24" X 24" for plumbing-related items
3. 36" X 36" for mechanical-related items

C. Furnish access panels of proper size to service concealed valves, cleanouts, etc. as required. Panels shall be of the proper type for the material in which they occur and are to be furnished by the Contractor but installed by the trade for the material in which the access panel is installed.

D. Panels shall have flush doors with sixteen (16) gauge steel door; sixteen (16) gauge frame; metal wings for keying into construction; concealed hinges; screwdriver-operated stainless steel cam lock; shop-coated with one (1) coat of zinc chromate primer.

E. Access panels shall not be installed in gypsum ceilings in public spaces.

F. Valves above removable ceilings shall have tile clips by the Contractor for identification.

2.3 INSULATION

A. The following system(s) shall be insulated:

1. All domestic cold-water piping above grade except at horizontal chase branch piping to individual plumbing fixtures.

2. All domestic cold-water piping above grade within fifteen (15) feet from service entry and within five (5) feet from exterior walls.

3. All domestic hot water and hot water return piping except at horizontal chase branch piping to individual plumbing fixtures.

4. All domestic water piping exposed to areas subject to freezing. Refer to Section 22 05 00, Subsection 2.4 “HEAT CABLE FOR FREEZE PROTECTION OF PIPING” for additional requirements and information.

B. Domestic water and waste drainage piping shall be insulated with four (4) lbs. density sectional fiberglass insulation. Insulation thermal conductivity k-value shall not exceed 0.24 and insulation shall have white “all service jacket” with vapor barrier. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with “all service jacket” three (3) inch wide tape. Insulation shall be used for exposed piping.

C. Acceptable manufacturers:

1. Johns Manville “Micro-Lok AP-T”

2. Knauf “ASJ/SSL”

3. Owens Corning “ASJ/SSL”

D. Minimum requirements for piping system insulation and insulation thickness shall be as shown in the table below:

MINIMUM PIPE INSULATION			**PIPE SIZE INSULATION THICKNESS (Ø)**				
SYSTEM	**FLUID TEMP RANGE**		**≤ 1”**	**1-1/4” – 2”**	**2-1/2” – 4”**	**5” and 6”**	**≥ 8”**
	°C	*°F*	*inch*	*inch*	*inch*	*inch*	*inch*
Domestic cold water	ambient	ambient	0.5	1.0	1.0	1.0	-
Domestic hot water and hot water return	43.0 – 71.0	110.0 – 160.0	1.0	1.5	1.5	1.5	-
Sanitary waste above grade receiving condensate or ice machine discharge	4.5 – 15.5	40.0 – 60.0	0.5	1.0	1.0	1.5	-
Primary and secondary storm drainage	ambient	ambient	-	-	1.0	1.0	1.0

E. Insulate all horizontal sanitary waste piping receiving air-conditioning condensate or ice machine discharge with minimum one (1) to one and one-half (1.5) inch fiberglass

insulation with jacket. Begin from the floor drain, including the p-trap, and insulate all the way to the change in direction at the vertical drop to below grade.

F. Aluminum jacketing:

1. Jacket for piping shall be 0.016 inches thick, type 3105 aluminum with factory-applied one (1) mil polykraft moisture barrier.

2. Covers for fittings shall be 0.024 inches thick, type 1100 aluminum to match pipe covering.

3. Aluminum jacketing shall be provided for all exposed piping.

4. Acceptable manufacturers:

a. ITW Insulation Systems Pabco/Childers

b. RPR Products

2.4 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

A. Provide electric heat cabling on all domestic water piping and sanitary traps exposed to areas subject to freezing.

B. Acceptable manufacturers:

1. Raychem

2. Chromalox

3. BriskHeat

4. Thermon

C. Provide Raychem XL-Trace or an approved, accepted manufacturer. Heat cable shall operate at five (5) watts per foot, 120VAC, and without the use of transformers. Provide the quantity of 120VAC branch circuits required to serve the entirety of the heat cable load at a maximum of 1800 watts per circuit.

D. Installation shall consist of a complete system of Raychem RayClic connection kits, or an equal, accepted manufacturer, with a complete circuit that provides the required power connections, end seals, and controllers to ensure proper freeze protection. Splices, tees, and connection kits are used as required. Installation shall be as recommended by the manufacturer.

E. Heat cable circuit shall be protected by a ground fault device for equipment protection. Provide this requirement in accordance with section 427.22 of the latest, applicable NEC.

F. Provide a complete system of self-regulating heat cable on all domestic water piping in crawl spaces, un-conditioned attic spaces, outdoors, and any other locations subject to freezing. Heat cable, accessories, and controls to prevent systems from freezing shall be UL Listed, CSA Certified, or FM Approved. Heat cable component enclosures shall be NEMA 4X rated to prevent external water ingress and corrosion. Heat cable shall conform to all requirements as specified in the Contract Documents under Division 26 (Electrical).

G. Heat cable shall be installed prior to insulation of the piping system and after all testing of the protected piping systems are complete. Heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc.

H. Heat cable shall be capable of maintaining a minimum water temperature of 40°F at an ambient air temperature of 0°F.

I. Heat cable shall be self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core which varies its resistance continuously with changes in temperature. A constant wattage heating method shall not be acceptable.

J. Provide an adjustable thermostat control which de-energizes the self-regulating heat cable when the ambient air temperature is above a set temperature. Default temperature setting of the thermostat control shall be set to de-energize when the ambient air temperature is above 40°F.

K. Installation shall not require the installing Contractor to cut into the heating cable core to expose the bus wires. Systems whose connection methods require the installing Contractor to strip the bus wires, use crimps, or use terminal blocks shall not be acceptable.

L. Provide all power connection hardware, splices, end seals, etc. to accomplish installation. All hardware shall be of the same manufacturer as the heat cable.

M. Provide a minimum of one (1) inch thick fiberglass insulation on all piping with heat cabling.

2.5 HEAT CABLE FOR TEMPERATURE MAINTENANCE OF PIPING

A. Provide electric heat cabling on all domestic hot water piping to maintain the temperature of the fluid in the piping downstream of the domestic hot water loop. Provide up to within twenty-four (24) inches of the fixtures being served to meet all the mandates of the energy efficiency codes per the City of Houston.

B. Acceptable manufacturers:

1. Raychem
2. Chromalox
3. BriskHeat
4. Thermon

C. Provide Raychem HWAT-R2 with Raychem HWAT-ECO-GF controller or an equal, accepted manufacturer. Heat cable shall operate at 208VAC or 277VAC and without the use of transformers. Provide the quantity of 208VAC and 277VAC branch circuits required to serve the entirety of the heat cable load.

D. Installation shall consist of a complete system of Raychem RayClic connection kits, or an equal, accepted manufacturer, with a complete circuit that provides the required power connections, end seals, and controllers to ensure proper water temperature maintenance. Splices, tees, and connection kits are used as required. Installation shall be as recommended by the manufacturer.

E. Heat cable circuit shall be protected by a ground fault device for equipment protection. Provide this requirement in accordance with section 427.22 of the latest, applicable NEC.

F. Provide a complete system of self-regulating heat cable on all domestic hot water piping that is non-circulated. Heat cable, accessories, and controls to maintain water temperature shall be UL Listed, CSA Certified, or FM Approved. Heat cable component enclosures shall be NEMA 4X rated to prevent external water ingress and corrosion. Heat cable shall

conform to all requirements as specified in the Contract Documents under Division 26 (Electrical).

G. Heat cable shall be installed prior to insulation of the piping system and after all testing of the domestic hot water system is complete. Heat cable shall be installed linearly along the top of the pipe when passing through pipe hangers and at the four (4) or eight (8) o'clock position on linear runs. Affix the cable to the pipe every two (2) feet with Raychem AT-180 tape or an equal, accepted manufacturer. Heat cable shall not be compressed or pinched between two objects and allowance shall be made for all fittings, valves, pipe supports, etc.

H. Penetrations through fire-rated assemblies shall have its own sleeve with fire resistant material equal to STI Firestop.

I. Heat cable shall be capable of maintaining a minimum water temperature of 105°F and a maximum temperature of 140°F at an ambient air temperature of 50°F.

J. Heat cable shall be self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core which varies its resistance continuously with changes in temperature. A constant wattage heating method shall not be acceptable.

K. Provide an adjustable thermostat control which de-energizes the self-regulating heat cable when the ambient air temperature is above a set temperature. Default temperature setting of the thermostat control shall be set to de-energize when the ambient air temperature is above 100°F.

L. Installation shall not require the installing Contractor to cut into the heating cable core to expose the bus wires. Systems whose connection methods require the installing Contractor to strip the bus wires, use crimps, or use terminal blocks shall not be acceptable.

M. Provide all power connection hardware, splices, end seals, etc. to accomplish installation. All hardware shall be of the same manufacturer as the heat cable.

N. Provide a minimum of one (1) inch thick fiberglass insulation for piping with heat cabling up to one (1) inch in diameter. For larger pipe sizes, refer to the manufacturer requirements and guidelines.

2.6 FLASHING

A. Vent pipes passing through roof shall be flashed watertight.

B. Roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.

C. All vent piping shall be offset above ceilings or in attic spaces as required to penetrate roofs on the least-visible side(s) of the building.

2.7 FLOOR, WALL, AND CEILING PLATES

A. Furnish and install heavy gauge, chromium-plated, steel wall and ceiling plates on all exposed pipes in finished areas where piping passes through walls, ceilings, etc.

B. Plates shall be of the type that will remain permanently in position and, where pipes are insulated, they shall be of the size necessary to cover insulated piping.

2.8 DRAIN PAN

A. Acceptable manufacturers:

1. DiversiTech
2. Killarney Metals
3. Riverside Sheet Metal

B. Furnish and install eighteen (18) to twenty-four (24) gauge galvanized steel pan under all above grade plumbing piping in the electrical rooms, MDF rooms, and IDF rooms.

C. Furnish and install eighteen (18) to twenty-four (24) gauge galvanized steel pan for water heaters.

D. Drain pan shall have at least two (2) inches in depth and shall extend at least six (6) inches beyond the plumbing pipe or equipment.

E. Drain pan shall be installed at least six (6) feet above electrical panels and electrical gear for accessibility and maintenance clearances and shall be installed within six (6) inches below the plumbing pipe or equipment.

F. Provide steel strut channels and hangers for drain pan support.

2.9 TRACER WIRE

A. All trace wire and trace wire components shall be domestically manufactured in the United States of America.

B. All trace wire shall have HDPE insulation intended for direct bury and color-coded per APWA standards for the specific utility being marked.

C. All trace wire shall be provided for underground, non-metallic system mains four (4) inches and larger.

1. Trace wire shall be installed in the trench on top of the underground, non-metallic piping and then attached to a metal pipe above slab at the end of the run. The wire under Division 22 scope shall extend a maximum of five (5) feet outside the building exterior to an access point.

a. Access point shall be located such that it is easily accessible for maintenance personnel and in coordination with the surrounding Architectural and Civil elements.

D. Acceptable manufacturers:

1. Copperhead Industries

E. Trace wire (copper-clad steel):

1. Open trench installation: direct burial 12AWG, solid steel core, soft drawn tracer wire with 250 lbs. average tensile break load, thirty (30) mil high-density polyethylene jacket complying with ASTM D1248, and thirty (30) volt rating. Refer to Section 22 05 00, Subsection 3.8 “TRACER WIRE EXECUTION” for additional requirements and information. Provide Copperhead Industries “1230-SF” or an equal, accepted manufacturer.

2. Directional bore or jacketed installation: direct burial 12AWG, solid steel core, hard drawn, extra high strength, horizontal directional drill tracer wire with 1,150 lbs. average tensile break load, forty-five (45) mil high-density polyethylene jacket complying with ASTM D1248, and thirty (30) volt rating. Refer to Section 22 05 00,

Subsection 3.8 “TRACER WIRE EXECUTION” for additional requirements and information. Provide Copperhead Industries “1245-HS” or an equal, accepted manufacturer.

F. Connectors (copper-clad steel):

1. Splices along the continuous run of trace wire for repair of a wire break or replacement of a filed segment of wire shall use 3M “Direct Bury Splice Kits” or an equal, accepted manufacturer. Acceptable alternative products by other manufacturers shall be capable of securely connecting two or more wires, effectively seal against moisture by means of a dielectric, non-hardening, silicone sealant, be approved for direct burial, and be rated for a minimum of fifty (50) volts.

2. Branch connections for laterals, turnouts, services, and appurtenances shall use King Innovation “DryConn” Waterproof Direct-Bury Lug Connectors (Aqua) or an equal, accepted manufacturer. Acceptable alternative products by other manufacturers shall be capable of securely connecting one or two wires to the main trace wire without cutting the main trace wire, effectively seal against moisture by means of a dielectric, non-hardening, silicone sealant, be approved for direct burial, and be rated for a minimum of fifty (50) volts.

   a. The intent of this specification is to provide connection terminations at main branches serving separate buildings, separate sections of a building, turnouts, services, and appurtenances. The tracer wire shall be capable of continuing along all under slab main runs such that, when energized, the resulting tone continues for that part of the associated segment of the underground system.

3. Non-locking, friction fit, twist-on, and taped connectors shall not be acceptable. Twisting of copper wiring shall not be acceptable.

G. Termination and access (copper-clad steel):

1. Termination and access point shall be located a maximum of five (5) feet outside the building exterior. Provide Copperhead Industries “SnakePit” access point or equivalent product by alternative manufacturer that is compatible with the complete tracer wire system.

2. Terminal box shall be flush mount type for installation at grade level. Terminal box shall be specifically manufactured for such application.

3. Terminal box shall consist of tubular housing, terminal board, and removable round lid.

4. Minimum dimensions shall be five and one-half (5.5) inches diameter and eight (8) inches high. Base shall be sized to fit four (4) inch PVC Schedule 40 pipe.

5. Housing and terminal board material shall be high strength ABS or polycarbonate plastic. All materials of the construction shall be impervious to chemicals typically used for snow and ice removal as well as pavement and hardscape maintenance.

6. Housing and lid shall be designed for easy access and maintenance:

   a. Turf and landscape areas:

      1) Light-duty housing with plastic lid

b. Hardscape areas:

1) Heavy-duty housing with cast iron or ductile iron lid

c. Roadway, driveway, and parking lot applications shall not be acceptable.

7. Terminal board shall have nickel-plated brass terminals. Terminal quantity for necessary and complete installation of the system shall be provided as required with a minimum of four (4) spare terminals provided.

H. Grounding (copper-clad steel):

1. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of twenty (20) feet of 14AWG, red, HDPE insulated, copper-clad steel wire connected to the anode (minimum 0.5 lbs.) that is specifically manufactured for such applications and shall be buried at the same elevation as the utility.

2. Drive-in magnesium anode shall be Copperhead Industries “ANO-1005” (1.5 lbs.) or an equal, accepted manufacturer.

2.10 PIPING SYSTEMS IDENTIFICATION

A. A marker showing the service and an arrow indicating the direction of flow shall be applied to the piping systems below and as applicable to the scope of work installed under this Division:

1. Condensate

2. Domestic water (cold, hot, hot return)

3. Fuel (oil)

4. Gas

5. Heat trace

6. Sanitary (vent, waste)

7. Storm drainage (primary, secondary)

B. Piping identification shall be applied to all piping systems in areas of exposed construction and in areas with accessible ceilings as well as in the following locations:

1. Both sides of each wall, floor, and ceiling penetration

2. Connections to equipment

3. Adjacent to valves and flanges

4. Adjacent to piping obstructed from view

5. Heat trace pipe runs at no more than ten (10) foot intervals or as required by the local code

6. Straight pipe runs at no more than twenty-five (25) foot intervals

C. Adhesive type labels shall not be acceptable, provide only “snap-around” or “snap-on” type labels.

D. The letter size, background color, and placement of markers shall conform to the requirements of ANSI/ASME A13.1 as well as all OSHA requirements. Identify all interior exposed piping and all piping in chases or plenums with a plastic “snap-around” or “snap-on” label indicating pipe system type and direction of flow arrow. Contractor shall clean piping prior to plastic marker installation. Provide consistent manufacturer for plastic markers of each system such that marker background colors, arrows, and system description are visually identical. Each system shall be clearly identified with a minimum letter size of two and one-quarter (2.25) inches for pipe sizes up to four (4) inches and a minimum letter size of four (4) inches for pipe sizes larger than four (4) inches.

E. Acceptable manufacturers:

1. Seton Nameplate Corporation

2. Brady Corporation

F. Each valve in the Division 21 and Division 22 systems shall be tagged with an individual number stamped onto the valve’s tag. Provide identification tags on all emergency fixtures and equipment shut-off valves.

G. Valve tags shall be brass or plastic laminate, a minimum diameter of one and one-half (1.5) inches, and shall have a brass chain with hook for securing the valve tag to the valve.

H. Valve tags shall include “P” or “FP” lettering designation to indicate the appropriate plumbing or fire protection system, respectively. Valve tag numbering shall be consecutive for each service of the plumbing or fire protection systems.

I. Provide a printed, compiled list or schematic drawing for each system indicating the tagged locations as well as a detailed description of the system or equipment being served.

J. Provide one (1) copy of each list or drawing that shall be framed and mounted at the location designated by the Building Engineer. Provide an additional copy of each list which shall be included in the O & M manual.

2.11 EQUIPMENT LABELING

A. All equipment shall be labeled; this shall include all pumps, water heaters, storage tanks, compressors, water treatment systems, utility controllers, and other similar equipment.

B. Equipment labeling shall be completed with the following items, unless noted or specified otherwise:

1. Submit schedule of equipment to be included and their designations.

2. Provide nameplates with one-half (0.5) inch high letters and fastened with epoxy or screws.

PART 3 – EXECUTION

3.1 OWNER INSTRUCTION – GENERAL

A. Provide on-site Owner training for all new equipment by factory trained specialists.

B. Use O & M manuals and actual equipment installed as the basis for instruction.

C. At conclusion of on-site training program, the Contractor shall have Owner personnel sign written certification that they have completed training and understand equipment operation. Include copy of training certificates in final O & M manual.

D. No retainage shall be released until the Owner has received all O & M manuals and as-built drawings as well as performed a first O & M walk.

E. Refer to individual equipment specifications for additional training requirements.

3.2 INSTRUCTION OF OWNER PERSONNEL

A. Prior to final inspection, the Contractor shall conduct an on-site training program to instruct the Owner's operating personnel of the operation and maintenance for the installed plumbing systems.

1. Provide the training during the Owner's regular working hours.

2. The instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems with the project.

B. Time to be allocated for on-site training program:

1. Minimum of eight (8) hours dedicated instructor time

2. Minimum of four (4) hours per day for two (2) days

C. Before proceeding with the on-site training program, the Contractor shall submit the program syllabus, proposed times and dates, and other pertinent information for review and approval by means of:

1. One (1) copy to the Owner

2. One (1) copy to the Architect

3. One (1) copy to the Engineer

D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.

E. Use the O & M manuals as the basis of instruction. Review contents of manual in detail with personal to explain all aspects of operation and maintenance.

F. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each equipment item.

G. Demonstrate equipment functions both individually and as part of the total, integrated system.

H. Prepare and insert additional data into the O & M manual when the need for additional data becomes apparent during instruction and training.

I. Submit a report within one (1) week after completion of the on-site training program that demonstrations and instructions have been satisfactorily completed. Provide time, date, and hours devoted to each demonstration and instruction with a list of personnel in attendance.

J. At the conclusion of the on-site training program, the Contractor shall have an Owner-designated individual sign a certificate to certify that they have a proper and thorough understanding of the demonstrated and instructed systems. By signing the certificate, the individual agrees that all demonstrations and instructions have been satisfactorily completed regarding the scope and content of the O & M manuals used in the on-site training program.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each O & M manual.

L. At the time of the MEP punch list walk, plumbing contractor to demonstrate accessibility and proper removal of every clean-out plug with the use of a special tool. If a special tool IS required, three copies must be turned over to GPISD at close-out. Prior to substantial completion and after terrazzo, tile installation and painting has been completed, camera all sanitary and storm lines below slab.

3.3 GENERAL REQUIREMENTS

A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections required for a complete and satisfactory startup.

B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed in such a manner and sequence as to avoid damage of components and as required by jobsite progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical, mechanical, technology, and architectural work. Equipment, accessories, and similar items requiring normal servicing or maintenance shall be easily accessible.

C. The Engineer reserves the right to direct the removal of any item which, in their opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.

D. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.4 STORAGE AND PROTECTION OF MATERIALS

A. During construction, all equipment shall be properly protected against damage, defacing, and freezing with manufacturer supplied or recommended shipping cartons, plastic sheeting, shipping covers, etc.

B. All open ends of piping and equipment shall be sealed with nipples, caps, plugs, and test plugs until final connection(s) to the system is made.

C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction with protective covers at the following instances:

1. Floor sink opening: Protect and cover with heavy-duty plywood or heavy-duty plastic cover by SmartGuard.

2. Floor drain opening: Protect and cover with heavy-duty plastic cover by SmartGuard.

3. Cleanout opening: Protect and cover with heavy-duty plastic cover by SmartGuard.

4. Pipe opening: Protect and cover with heavy-duty plastic cover by SmartGuard.

5. Fixture opening(s): Protect and cover with plastic sheet cover until final punch list.

D. Handle and store materials in accordance with the manufacturer and supplier recommendations and in a manner preventing damage to the materials during storage and handling. Replace all damaged materials.

E. Equipment and materials shall not be installed until the environmental conditions of the jobsite are suitable to satisfactorily protect the equipment and materials. Equipment and materials damaged or subjected to adversarial environmental conditions shall not be acceptable and shall be removed from the jobsite and replaced accordingly.

F. Use of duct tape or other similar protection methods shall not be acceptable.

3.5 DEMOLITION, REMOVAL, AND EXTENSION OF EXISTING PLUMBING WORK

A. Disconnect plumbing and fire protection systems in walls, floors, and ceilings scheduled for removal.

B. During construction, provide all required connections to maintain operation of existing systems in service at the existing areas of the building(s) to remain.

C. Maintain access to existing installations to remain active. Modify installation or provide access panels as required to accommodate existing installations remaining active.

D. When performing work on operating systems, use personnel experienced and trained in similar systems.

E. Remove, relocate, and extend existing installations to accommodate new construction.

F. Remove all exposed and abandoned piping systems back to the source of supply, including abandoned systems above accessible ceilings. Cut systems flush with walls and floors, followed by patch and repairing affected surfaces as required.

G. Extend existing installations to remain using materials and methods compatible with the existing installation, or as specified.

H. Repair adjacent construction and finishes damaged during demolition and extension work as required.

I. Normal facility activities shall continue in existing areas to remain in service. MEPT systems servicing existing occupied spaces shall have service maintained and uninterrupted. The Contractor shall schedule any required outages and system service interruptions with the Owner and Architect. Submit a written request indicating service(s) and/or system(s) to be interrupted along with proposed duration and summary of work to be performed during downtime.

J. For removed equipment and fixtures:

1. Store items at jobsite. The Owner retains rights to all removed items.

2. Allow the Owner ample time to review removed items and to designate which items shall be kept by the Owner.

3. Dispose properly, off-site, all items the Owner chooses to relinquish.

3.6 REMOVAL OF EXISTING PLUMBING MATERIALS

A. The Contractor shall modify, remove, and relocate all materials and items as indicated on the Drawings or as required by the installation of new facilities. All material removal and dismantling shall be conducted in a manner as to produce maximum salvage. Salvage destination shall be as directed by the Owner. Materials and items scheduled for relocation and that are damaged during dismantling and reassembling shall be repaired and restored to satisfactory and original operating conditions. The Contractor may, at their discretion

and upon the approval of the Owner, substitute new materials and items of equal characteristics and quality in lieu of relocating materials and items.

B. All items which are scheduled for relocation shall be carefully removed in reverse of the original assembly or placement and shall be protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore relocated items to satisfactory and original operating conditions. All relocations shall be performed by workmen skilled in the work being done and in accordance with standard practice of the trade(s) involved.

C. When items scheduled for relocation are discovered to be in a damaged and irreparable condition before work to dismantle has begun, the Contractor shall bring such items to the attention of the Owner and shall wait to receive further instruction prior to removal. Items damaged during relocation shall be of the Contractor's responsibility and shall be repaired or replaced by the Contractor and as approved by the Owner. Such instances shall be at no additional cost to the Owner.

D. Service lines to items to be removed, salvaged, or relocated shall be removed to the points indicated on the Drawings, as specified, or as acceptable to the Owner. Service lines not scheduled for reuse shall be removed to the points at which reuse continues or existing service is to remain. Such services shall be sealed, capped, or otherwise tied-off and disconnected in a safe manner that is acceptable to the Owner. All disconnections or connections from or into the existing facilities shall be done in a manner resulting in minimum interruption of services to adjacent, occupied areas. Services to existing areas and facilities which are to remain in operation during the construction period shall not be interrupted without prior and specific approval of the Owner as herein specified.

E. Include in the contract price all rerouting of existing piping, fixtures, systems, etc. and all reconnections as necessitated by field conditions to allow the installation of the new item(s). Furnish all temporary piping, fixtures, systems, etc. as required to maintain plumbing services for the existing areas with minimal interruption.

F. The Contractor shall bear responsibility for loss or damage to the existing facilities to remain and shall bear responsibility for repairing such loss or damage. The Contractor shall send proper notices, make the necessary arrangements, and perform other services required for the care, protection, and operational maintenance of all plumbing services for the new and existing facilities. The Contractor shall erect temporary barricades with the necessary safety devices as required to protect personnel from injury and then removing all such temporary barricades upon completion of the work.

G. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall coordinate the removal of doors, piping, fixtures, conduit, wiring, outlet boxes, ductwork, equipment, etc. to provide such access and shall reinstall removed items upon completion of work in the affected areas.

H. Where partitions, walls, floors, and ceilings of existing construction are scheduled for removal, all Contractors shall coordinate the removal and reinstallation of such items in locations as approved by the Architect. The Contractors involved shall provide all devices required for the operation of the various systems installed in the existing construction.

3.7 EXCAVATION, TRENCHING, AND BACKFILLING

A. The Contractor shall perform all excavation required to install the work specified herein and as indicated on the Drawings. During excavation, material for backfilling shall be piled back from the trench banks to avoid overloading and to prevent slides and cave-ins. All

excavated materials not to be used for the backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and excavated areas. Any water accumulation therein shall be removed via pumping. All excavation shall be made by open cut. Tunneling and boring shall not be acceptable except underneath pavement.

B. The bottom of the trenches shall be graded to provide uniform bearing and supports for piping, fittings, etc. on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth and tamped in twelve (12) inch layers. Remove unstable soil that is not capable of supporting equipment or installation and replace with the specified material for a minimum of twelve (12) inches below invert elevation of the equipment or installation.

C. The Contractor shall coordinate and provide pipe supports as required per structural Drawings for any void form system such as piping under the slab, piping exiting the building, special requirements on the backfill, etc. and as such all piping shall be supported by an approved, suspended system.

1. System structure:

a. Provide a dimensionally stable underground void space that is independent from the overhead structural slab. The subterranean system shall support the weight of suspended lateral pipes, including all imposed loads, throughout the construction process.

b. The system shall be designed to have the ability to temporarily position and suspend the lateral pipes to the specified height and slope until permanently anchored to the overhead structural slab via securing hanger system. The open, underground system then remains independent from the securing hangers.

c. The open space of the system beneath the structural slab is designed to receive infill of vertical expansion from the underlying soils. If vertical pressure is applied to the edges of the system in contact with the soil, the uplifting soil pressure will become separate and allow the lateral pipes to be totally independent from the system.

2. System components:

a. The system shall maintain its structural integrity in all humid environment conditions and shall have waterproof components appropriate for its intended performance. All system components, excluding all thread rods, nuts, and washers, shall be furnished by the system manufacturer.

b. All vertical all thread rods shall have a component secured toward the top end and permanently affixed into the concrete slab to maintain the specified elevations.

c. System shall be installed per the manufacturer’s requirements and recommendations. The Contractor shall coordinate the system installation with the structural Drawings and the manufacturer guidelines as required.

D. The trenches shall be backfilled with cement-stabilized sand materials approved for backfill purposes, deposited in six (6) inch layers, and tamped until the crown of the pipe is covered by a minimum of six (6) inches of material.

1. Provide a sand-cement mixture producing a minimum unconfined compressive strength of one hundred (100) PSI in forty-eight (48) hours.

    a. Design shall be based on strength specimens molded in accordance with ASTM D588 at a moisture content within three (3) percent of optimum and within four (4) hours of batching.

    b. Determine minimum cement content from product data and statistical history. Provide no less than one and one-tenth (1.1) sacks of cement per ton of dry sand.

2. Cement: Portland cement Type I conforming to ASTM C150

3. Sand: Clean, durable sand meeting the grading requirements for fine aggregates of ASTM C33 and the following requirements:

    a. Classified as SW, SP, SW-SM, SP-SM, or SM by the Unified Soil Classification System of ASTM D2487.

    b. Deleterious materials:

        1) Organic impurities colored no darker than the standard color and conforming to the requirements ASTM C40.

        2) Lightweight pieces less than five (5) percent and conforming to the requirements of ASTM C123.

        3) Clay lumps less than one-half (0.5) percent and conforming to the requirements of ASTM C142.

    c. Plasticity index of four (4) or less when tested in accordance with the requirements of ASTM D4318.

E. Provide a layer of sand at least six (6) inches deep under all plastic pipe installed in soil. Bell end of pipe shall be excavated to ensure that the pipe rests for its entire length upon a solid trench bottom.

F. The backfill under and beside the pipe shall be compacted for pipe support. The backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer’s installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirements. The backfill process shall be carried out simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to ninety-five (95) percent of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water shall not be acceptable. Reopen any trenches not meeting compaction requirements or, where settlement occurs, the Contractor shall refill, compact, and restore the surface to the grade and compaction indicated as well as mounded over and smoothed off. A metallic-lined, underground warning tape shall be provided twelve (12) inches below finished grade. The warning tape shall be identifiable as to the type of line per OSHA and ANSI standard nomenclature and color.

G. Perform all excavation and backfill work in accordance with the applicable portions of the earthwork sections of the code.

3.8 TRACER WIRE EXECUTION

A. Trace wires shall be installed adjacent to nonmetallic underground water, gas, and main sewage lines underneath the building pad and stubbed up into a ground access well enclosure for the trace wire to connect to it. Trace wire shall be color coded for piping systems as follows:

1. Natural gas: yellow
2. Sanitary sewer: green
3. Storm sewer: green
4. Water (potable): blue
5. Water (non-potable): purple

B. Install trace wire as required by this Section and in accordance with the local codes:

1. Trace wire shall be installed in the same trench as its associated piping and shall be installed inside bored holes and casing with pipe during pipe installation. Trace wire shall be secured to the pipe as required to ensure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved, watertight connector to provide electrical continuity and shall be accessible at all trace wire access points.
2. Prior to backfill, install trace wire on top of pipe and secure in place with ties or hitches at a maximum of ten (10) foot intervals and in accordance with the local jurisdiction's water utility requirements. Run trace wire continuously along the pipe and terminate at access points. Where buried splices occur, use an approved electrical splicing kit only. Provide no less than twenty-four (24) inches of coiled wire at access points for attachment to pipe-locating equipment. Each installed pipe run shall be capable of being located using the trace wire system. Protect wire insulation from damage during installation and backfill. Wire insulation that is broken, cut, or damaged shall be replaced.
3. At the point of connection between existing, conductive pipes, the trace wire shall not be connected to the conductive pipe. This circumstance shall be treated as a mainline dead-end grounded using an approved, waterproof connection to a grounding anode and buried at the same depth as the trace wire. All such connections points shall be grounded.
4. Where existing trace wire is encountered on an existing pipe run that is being extended or tied into, the new and existing trace wire shall be connected using approved splice connectors, shall be properly grounded at the splice location(s) as specified, and shall be completely waterproof to prohibit corrosion and loss of conductivity.
5. Trace wire shall be laid flat and securely affixed to the pipe at the three (3) o'clock position. The wire shall be protected from damage during execution of the work. No breaks or cuts in the trace wire or trace wire insulation shall be permitted. At service saddles, placing the trace wire between the saddle and the main shall not be acceptable.
6. At all main end caps, a minimum of six (6) feet of trace wire shall be extended beyond the end of the pipe, coiled, and secured to the cap for future connections. The end of the trace wire shall be spliced to the wire of a six (6) lbs. zinc anode and buried at the same elevation as the pipe main.

7. Trace wire access points shall be accessible at all new water valve boxes. Concentrations of multiple proposed valve boxes near pipe intersections, e.g., tees and crosses, may require more than one access point assembly in each concrete valve box collar.

8. At the point of connection between ductile iron water mains and any dissimilar material, the trace wire shall be properly connected to the iron pipe with a “Cadweld” or approved equivalent. Trace wire welds shall be completely sealed with the use of an approved, mastic-type sealer specifically manufactured for installation at below grade. Mastic shall be applied in a thick coat at a minimum of one-quarter (0.25) inch in thickness and shall be protected from contamination by the backfill material with the use of a plastic membrane.

9. Trace wire systems shall be installed as a single continuous wire except where approved connectors are used. Looping or coiling of the wire shall not be acceptable.

10. Any damage occurring during the installation of the trace wire shall be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping or spray coating shall not be acceptable.

11. Open trench installation:

    a. Trace wire shall be placed a minimum of eight (8) inches above buried natural gas piping and nonmetallic piping for any service. For other utility piping systems, trace wire shall be laid directly upon pipe and attached at a maximum of ten (10) foot intervals with non-conductive tape. Additional attachment(s) shall be provided at offsets and fittings in the piping system. Trace wire shall be placed carefully, and great care shall be exercised during the backfill process to maintain physical integrity and position relative to piping.

    b. Splices in trace wire shall be kept to an absolute minimum. When splices are necessary, they shall be made with approved trace wire connectors as specified. Other splicing methods shall not be acceptable.

12. Directional bore or jacketed installation:

    a. Two (2) trace wires shall be provided with one (1) wire as backup.

    b. Trace wires shall be pulled through bore hole(s) in conjunction with utility piping. Wires shall be located on opposite sides of utility piping.

    c. Trace wire splices shall not be acceptable in drilled sections.

13. Trace wires shall be interconnected at intersections of mainlines and branches utilizing a single three-way connector at each point of connection.

14. A terminal box shall be provided at each building utility service entrance and shall be located above piping within five (5) feet of the point of entry into the building.

15. Terminal boxes shall not be located more than one thousand (1,000) linear feet of developed pipe length apart.

16. Terminal boxes shall not be installed at streets, drives, parking lots, or other areas subject to vehicular traffic.

17. Terminal boxes shall not be installed at areas where access to the box is impeded.

18. Terminal boxes shall be installed flush with finished grade and centered in grade-level concrete pads. Concrete pad shall be 18” X 18” minimum and shall be six (6) inches thick.

19. PVC pipe risers shall be firmly attached to the bottom of the terminal box housing and extended downward to an elevation approximately twelve (12) inches above piping. Riser shall serve as a vertical conduit for guiding trace wires into the bottom of the terminal box.

20. Care shall be taken to extend trace wire from utility pipe to the terminal box in an orderly and workmanlike manner as backfill is placed.

21. The end of each trace wire shall be properly landed on a dedicated terminal within the terminal box(es) and securely tightened. Twelve (12) to eighteen (18) inches of excess length shall be provided for each wire within a box. Each terminal shall be clearly identified with permanent labeling. Where trace wires for multiple utilities are terminated, care shall be taken to ensure accuracy of identification at both ends.

C. Testing:

1. All new trace wire installations shall be located using typical low frequency (512 hertz) line tracing equipment and witnessed by the Contractor, Engineer, and Owner’s designated representative prior to acceptance of ownership.

2. The verification shall be performed upon completion of rough grading and again prior to final acceptance of ownership.

3. Final testing of each trace wire shall be performed after the backfill process is complete, terminal boxes have been permanently installed, and wires are terminated. Testing shall be witnessed by the Architect, Engineer, and Owner’s designated representative. It may be advisable for the Contractor to perform preliminary test(s) during utility installation prior to final backfill and restoration. Testing shall be accomplished using typical low frequency line tracing equipment. Continuity testing in lieu of actual line tracing shall not be acceptable.

D. Perform all excavation and backfill work in accordance with the applicable portions of the earthwork sections of the code.

3.9 CONCRETE WORK

A. Construct curbs, pads, vaults, and similar supports for equipment where required.

B. First floor and equipment yard: provide a minimum of six (6) inch thick housekeeping pads at floor mounted equipment and a minimum of four (4) inches larger than the entire area occupied by equipment.

C. Second floor and above: provide a minimum of four (4) inch thick housekeeping pads at floor mounted equipment and a minimum of four (4) inches larger than the entire area occupied by equipment. Dowel pads to the structural slab.

D. Perform all concrete work in accordance with applicable portions of the concrete sections of the code. Minimum compressive strength of concrete shall be the same as specified for slabs on grade.

3.10 CLEANING OF PIPING SYSTEMS

A. Provide cleaning of installed piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to completely clean, purge, and circulate the system as required.

B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, fixtures, etc. shall be thoroughly cleaned both inside and out with the following minimum requirements:

1. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line-size blow down ball valve and pipe to nearest drain. Blow down, remove, and clean strainers as frequently as necessary.

2. Phase I: Initial flushing of systems. Remove loose dirt, mill scale, weld beads, rust, and other deleterious substances without damage to the system components. Open valves, drains, vents, and strainers at all system levels during flushing procedures. Flush until potable water is clear and particles larger than five (5) microns are removed. Connect dead-end supply and return headers, even if not shown on the Drawings, and provide terminal drains in bottom of pipe end caps or blind flanges. Dispose of water in an approved manner.

3. Phase II: Cleaning of piping systems. Remove, without chemical or mechanical damage to any system component, adherent dirt, organic soil, hydrocarbons, soldering flux, mill varnish, piping compounds, rust, and other deleterious substances not removed by initial flushing. Flush system and replace with clean, potable water.

4. Phase III: Final flushing and rinsing of systems. Flush and rinse until potable water is clear and particles larger than five (5) microns) are removed. Operate valves to dislodge any debris in the valve body. Dispose of water in an approved manner.

5. Submit status reports upon completion of each phase of work on each system.

3.11 TESTING OF PIPING SYSTEMS

A. General:

1. Prior to insulation and concealment, all piping systems shall be subjected to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until all joints are inspected.

2. All tests shall be witnessed by the inspector having jurisdiction and the Owner’s designated representative with a minimum of forty-eight (48) hours’ notice given to the parties involved.

3. All equipment, material, labor, and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.

4. All connected fixtures, equipment, accessories, etc. shall be isolated from the piping systems prior to testing.

B. Sanitary piping system:

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section enduring testing. All sections shall be tested with a minimum of ten (10) feet of head. In testing successive sections, at least the upper ten (10) feet of the next section shall be tested so that no piping joint in the building shall undergo a test consisting of less than ten (10) feet of head. The water shall be successfully kept in the system for at least thirty (30) minutes before inspection begins. The system shall then be made tight at all points.

2. Any point(s) of the drainage systems to be tested with air instead of water shall be performed by attaching a compressed air testing apparatus to any suitable opening and, after closing tight all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of five (5) PSI. This pressure shall be held without the introduction of additional air for a period of at least thirty (30) minutes.

3. Exterior connections shall be tested as part of the interior systems.

C. Interior water piping system:

1. Upon completion of the entire water supply system or a section of it as required, the system shall be tested prior to connection of fixtures, equipment, accessories, etc. and proved tight under a water or air pressure test of at least one hundred and fifty (150) PSI. Pressure shall hold for a period of one (1) hour without introducing additional water or air. Water used for testing shall be from a potable supply source. Defective joints or piping shall be replaced as required and all piping shall be retested as required.

D. Exterior water piping system:

1. All exterior domestic water piping shall be tested to one hundred and fifty (150) PSI for a period of two (2) hours.

E. Defective work:

1. If inspection or tests show defects, such defective work or material shall be replaced, and the inspections and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes shall not be acceptable.

F. Additional tests:

1. Provide all additional tests such as smoke, pressure, etc. as required by the regulations or as directed by jurisdictional authorities making the inspection.

2. Provide for any repeated test as directed by the Owner’s designated representative to ensure all systems are tight as required.

3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.12 OPERATING TESTS

A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and performance through the range of its operations. Tests shall be made in the presence of the Architect and Engineer. Provide adjustments as required to ensure proper functioning

of all systems. Special tests on individual systems are specified under their respective Specification Sections.

B. Submit three (3) copies of all certifications and test reports in a timely manner ahead of work completion to allow adequate time for remedial action as required to correct deficiencies discovered in the equipment and plumbing systems.

3.13 DISINFECTION OF INTERIOR AND EXTERIOR WATER SYSTEMS

A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.

B. Whenever the authorities having jurisdiction do not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than fifty (50) parts per million of chlorine. The chlorinating solution shall be liquid chlorine of sodium hydrochloride solution and shall be introduced and drawn to all points in the system. The disinfecting solution shall be allowed to remain in the system for a period of eight (8) hours, during which period all valves and faucets shall be opened and closed several times. After disinfection, the solution shall be thoroughly flushed from the system with clear, potable water until the residual chlorine content is no more than two-tenths (0.2) parts per million.

C. This work shall be supervised or performed by an approved chemical testing laboratory and the results shall be sent to the Engineer or their representative for verification.

3.14 OPERATION AND MAINTENANCE MANUALS

A. Form of manuals:

1. Prepare data in the form of an instructional manual for use by the Owner’s personnel.

2. Format:

   a. Size: Letter size (8.5” X 11”).

   b. Text: Manufacturer’s printed data or neatly typewritten equivalent.

3. Drawings:

   a. Provide reinforced punched binder tab and bind in text.

   b. Fold larger drawings to be of at least the same format size as specified hereinbefore.

4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.

5. Cover:

   a. Identify each volume with the printed title, “Operating & Maintenance Instructions” and include the following elements:

      1) Title of project

      2) Identity of separate structures or facilities as applicable

      3) Identity of general subject matter covered in that specific volume

6. Bind as specified.

B. Content of manuals:

1. Provide a neatly typewritten table of contents for each volume, arranged in a systematic order as outlined in the Specifications, and include the following elements:

a. The Contractor name, name of responsible principal, address, and telephone number

b. Each product required to be included in the table of contents and indexed appropriately to the content of the volume

c. Each product's associated address, telephone number, and name of:

1) The Subcontractor or installer

2) Maintenance Contractor, if applicable

3) Identify areas of responsibilities for each party

4) Local source of part supplies and part replacement

d. Identify each product by the product name and other identifying symbols as set forth in the Contract Documents.

2. Product data:

a. Include sheets pertinent to the specific product.

b. Annotate each sheet to:

1) Identify specific product or part installed

2) Identify data applicable to installation

3) Delete references to inapplicable information

a) All options not supplied with equipment shall be marked out or indicated in some manner.

3. Drawings:

a. Supplement product data with drawings as necessary to illustrate:

1) Relations of component parts of equipment and systems

2) Controls and flow diagrams

b. Coordinate drawings with information in the Project Record Documents to assure correct illustration of completed installation.

c. Do not use the Project Record Documents as maintenance drawings.

4. Written text, as required to supplement product data for a specific installation, shall include:

a. Separate headings for different procedures and organized in a consistent format

b. Logical sequence of instructions for each procedure

5. Copy each warranty, bond, and service contract issued.

a. Provide an information sheet for the Owner's personal indicating:

1) Proper procedures in the event of failure

2) Instances that might affect validity of warranties or bonds

6. Shop drawings, coordination drawings, and product data as specified.

C. Sections for equipment and systems:

1. Content for each unit of equipment and system as applicable:

a. Description of unit and component parts:

1) Function, normal operating characteristics, and limiting conditions

2) Performance curves, engineering data, and tests

3) Complete nomenclature and commercial number of replaceable parts

b. Operating procedures:

1) Startup, break-in, routine, and normal operating instructions

2) Regulation, control, stopping, and emergency shutdown instructions

3) Summer and winter operating instructions

4) Special operating instructions

c. Maintenance procedures:

1) Routine operations

2) Guide to troubleshooting

3) Disassembly, repair, and reassembly

4) Alignment, adjusting, and checking

5) Routine service based on operation hours

d. Servicing and lubrication schedule as well as a list of lubricants required.

e. Manufacturer's printed operating and maintenance instructions.

f. Description of sequence of operation by the controls manufacturer.

g. Installed equipment and system control diagrams by the controls manufacturer.

h. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance. Include:

1) Predicted life of each part subject to wear

2) Items recommended to be stocked as spare parts

i. Complete equipment internal wiring diagrams.

j. Each Contractor's coordination drawings.

k. Color-coded piping diagrams of the installed equipment and systems.

l. Charts of valve tag numbers with location and function of each valve.

m. Other data as required under relevant sections of the Specifications.

2. Prepare and include additional data when the need for such data becomes apparent during instruction of the Owner's personnel.

3. Additional requirements for operating and maintenance data as outlined in relevant sections of the Specifications.

4. Provide complete information for products specified in Division 22.

5. Provide certificates of compliance as specified in each related section of the Specifications.

6. Provide startup reports as specified in each related section of the Specifications.

7. Provide signed receipts for spare parts and materials.

8. Provide training report and certificates.

9. Provide backflow preventer certification test reports.

10. Provide gas piping pressure test reports.

END OF SECTION 22 05 00

SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Expansion joints
2. Pipe alignment guides
3. Pipe anchors

B. Related Sections:

1. 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
    a. Product and installation requirements for piping hangers and supports.

1.3 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints shall adequately provide protection of the system.

B. Expansion compensation design criteria:

1. Installation temperature: fifty (50) degrees Fahrenheit
2. Domestic hot water: one hundred and forty (140) degrees Fahrenheit
3. Safety factor: thirty (30) percent

1.4 SUBMITTALS

A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.

B. Shop drawings: indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets, and swing joints. Submit shop drawings sealed by a registered Professional Engineer.

C. Product data:

1. Flexible pipe connectors: indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
2. Expansion joints: indicate maximum temperature, pressure rating, and expansion compensation.

D. Submit calculations of the design data indicating calculation criteria and sealed by a registered Professional Engineer.

E. Submit special procedures as required by the manufacturer's installation instructions.

F. Submit manufacturer's certificate indicating the submitted products meet or exceed the specified requirements.

G. Submit welders' certificate indicating compliance with all American Welding Society (AWS) D1.1 "Structural Welding Code – Steel Endorsement Description" requirements.

H. Submit manufacturer's field reports indicating results of inspection by the manufacturer's designated representative.

I. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.5 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 01 – General Requirements and each Specification Section.

B. Project Record Documents:

1. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Submit adjustment instructions as required by the equipment or system operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with ASME B31.9 "Building Services Piping" for installation of piping systems and ASME BPVC-IX "Welding, Brazing, and Fusing Qualifications" for welding materials and procedures.

1.7 QUALIFICATIONS

A. Installer: the company must specialize in performing work of this Section with a minimum of three (3) years of documented experience.

B. Design expansion compensating systems under the direct supervision of a Professional Engineer experienced in design of this work and licensed at the location of the jobsite.

1.8 WARRANTY

A. Furnish a five (5) year manufacturer warranty for leak-free performance of packed expansion joints.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept expansion joints onsite in factory packing with shipping bars and positioning devices intact. Inspect for damage.

B. Protect equipment from exposure by leaving factory coverings, pipe end protections, and packaging in place until installation.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All equipment, materials, accessories, etc. necessary for the work required shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the manufacturer-intended use and shall be subject to approval by the Engineer.

B. All equipment, products, and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

2.2 EXPANSION JOINTS

A. Acceptable manufacturers:

1. VMC/Amber Booth
2. Triplex
3. Mason Industries
4. Uponor

B. Stainless steel bellows type:

1. Pressure rating of two hundred (200) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit; for use with water, oil, gas
2. Maximum compression: one and three-quarters (1.75) inch
3. Maximum extension: one-quarter (0.75) inch
4. Joint: provide as specified for pipe joints
5. Size: provide as per pipe size
6. Application: steel piping three (3) inches and smaller

C. External ring controlled stainless steel bellows type:

1. Pressure rating of two hundred (200) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit; for use with water, oil, gas
2. Maximum compression: fifteen-sixteenths (0.9375) inch
3. Maximum extension: five-sixteenths (0.3125) inch
4. Maximum offset: one-eighth (0.125) inch
5. Joint: flanged
6. Size: provide as per pipe size
7. Accessories: internal flow liner
8. Application: steel piping three (3) inches and larger

D. Double sphere flexible type:

1. Construction: multi-layered Kevlar tire cord fabric reinforced with peroxide-cured EPDM cover, liner, and fabric frictioning

2. Pressure rating of two hundred and fifteen (215) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit

3. Maximum compression: one and one-quarter (1.25) inch permissible compression for up to six (6) inch pipe size; one and one-half (1.5) inch permissible compression for eight (8) inch pipe size and up to twelve (12) inch pipe size; one and one-fifth (1.2) inch permissible compression for fourteen (14) inch pipe size.

4. Maximum elongation: three-quarters (0.75) inch permissible elongation for up to six (6) inch pipe size; one and one-half (1.5) inch permissible elongation for eight (8) inch pipe size and up to twelve (12) inch pipe size; five-eighths (0.625) inch permissible elongation for fourteen (14) inch pipe size.

5. Maximum offset: three-eighths (0.375) inch permissible offset for up to six (6) inch pipe size; seven-eighths (0.875) inch permissible offset for eight (8) inch pipe size and up to twelve (12) inch pipe size; one (1) inch permissible offset for fourteen (14) inch pipe size.

6. Maximum angular movement: fifteen (15) degrees

7. Joint: steel or ductile iron flanges

8. Size: provide as per pipe size

9. Accessories: control rods

10. Application: steel piping three (2) inches and larger

E. PEX-a pipe support:

1. For use with Uponor PEX-a pipe

2. Continuously support PEX-a piping with manufacturer approved pipe support systems and utilize fixed anchor points every:

   a. Sixty-five (65) feet for domestic hot water

   b. One hundred and fifty (150) feet for domestic cold water

3. Utilize manufacturer-provided stainless steel straps to secure the PEX-a pipe supports to the pipe at the intervals specified in the manufacturer’s installation instructions.

4. Refer to the Uponor “Plumbing Design Assistance Manual” (PDAM) for more information.

2.3 ACCESSORIES

A. Acceptable manufacturers:

1. VMC/Amber Booth

2. Triplex

3. Mason Industries

B. Pipe alignment guides: two-piece welded steel, bolted, with enamel paint and with spider to fit standard pipe; frame with four mounting holes; clearance for minimum of one (1) inch thick insulation; minimum of three (3) inches for travel.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine piping layout and notify the Architect and Engineer of additional anchors or expansion joints required to adequately protect the system.

B. Provide inspection services by the flexible pipe manufacturer's designated representative for final install and certify that the installation is in accordance with the manufacturer's recommendations as well as that the connectors are performing satisfactorily.

3.2 INSTALLATION

A. Install work in accordance with ASME B31.9 "Building Services Piping" and any applicable local codes.

B. Install piping to allow for expansion and contraction without stressing piping, joints, or connected equipment.

C. Flexible piping shall not be used in concealed spaces. Access panels shall be provided for concealed space installations.

D. Provide supports and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints or expansion joints where required. Refer to Section 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT for pipe hanger installation requirements.

E. Provide grooved piping systems with a minimum of one (1) joint per inch of pipe diameter instead of flexible connectors supported by vibration isolation. Grooved piping systems need not be anchored.

F. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to the isolated equipment and anchor the other end.

G. Provide expansion loops as per the pipe manufacturer's design guidelines or as indicated on the Drawings. Rigidly anchor pipe to the building structure where necessary and as required. Provide pipe guides so that movement takes place along the pipe's axis only. Rigidly anchor pipe to the building structure to prevent stress, strain, and loading transfer to connected equipment.

H. Coordinate with the installation of piping seismic braces so that they do not interfere with thermal expansion loop action or building joint loop action.

I. Install expansion compensating devices for PEX-a piping in accordance with the manufacturer's installation instructions.

END OF SECTION 22 05 16

SECTION 22 05 29 - PLUMBING HANGERS AND SUPPORTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SUBMITTALS

A. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
   2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

C. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.
   2. Firestopping: Submit preparation and installation instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.

C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
1. Unistrut Corp.
2. Erico Caddy.
3. PHP System.
4. Anvil/Anvil Strut.
5. BLINE.

B. Pipe Supports:
1. Conform to MSS SP58.
2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring.
3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe sizes three (3) inches and Smaller: Cast iron hook.
6. Wall Support for Pipe sizes four (4) inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
   a. Provide at all system stub-ups from below grade thru ground floor slab.
8. Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
9. Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
10. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
12. Non-metallic pipe support: Vinyl-coated Hangers.
13. PEX Tube Support: CTS sized hangers or supports free of sharp edges.
14. Galvanized steel to be used for outdoor installation.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

B. Provide locking nuts on all rod extensions.

C. Galvanized steel to be used for outdoor installation.

2.3 INSERTS

A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 SLEEVES AND ESCUTCHEONS

A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event

that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.

B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.

C. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.

D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.

E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.

F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.

G. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.

H. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer’s approval.

I. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.

J. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling. Provide stainless steel sheet metal for exterior walls. Welded water ring sleeve shall be used on all exterior wall and floor penetrations.

K. Sealant: Acrylic

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline Link-Seal, Inc., or approved equal.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

A. Manufacturers:
   1. Unistrut Corp., or approved equal.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

A. Manufacturers:
   1. Dow Corning Corp. Model.
   2. 3M fire Protection Products Model.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
   1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
   2. Foam Firestopping Compounds: Multiple component foam compound.
   3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
   4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
   5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
   6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
   7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: Dark gray Black As selected from manufacturer’s full range of colors.

D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer’s system selector for more information.

2.8 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
   1. Mineral fiberboard.
   2. Mineral fiber matting.
   3. Sheet metal.
   4. Plywood or particle board.
   5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:
   1. Furnish UL listed products or products tested by independent testing laboratory.
   2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:
   1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
   2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing or damming materials to arrest liquid material leakage.

D. Do not drill or cut structural members.

E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.

F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with MSS SP 58.

B. Supports for Gas Piping:
   1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
   2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.

C. Supports for Cast Iron Piping:
   1. Vertical Piping:
      a. Support vertical piping and tubing at base and at each floor.
      b. Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at sufficient floor intervals to meet the requirements of local codes. Approved metal clamps or hangers should be used for this purpose.
      c. When vertical piping is to stand free of any support or if no structural element is available for support and stability during construction, secure the piping in its proper position by means of adequate stakes or braces fastened to the pipe.
   2. Horizontal Piping, Suspended:
      a. Support horizontal piping and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe by an approved hanger located not more than 18 inches from the joint.
      b. Support terminal ends of all horizontal runs or branches and each change of direction or alignment with an approved hanger.
      c. Provide hangers as necessary to provide alignment and grade. Provide hangers at each horizontal branch connection. Adequate provision should be made to prevent shear. Where pipe and fittings are suspended in excess of eighteen inches by means of non-rigid hangers, a sway bracing to be provided.
      d. An anchor or bracing to be provided on all storm drain pipe fittings.
   3. Place hangers within 12 inches of each horizontal elbow.
   4. Use hangers with 1-1/2 inch minimum vertical adjustment.
   5. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
   6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
   7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
   8. Support riser piping independently of connected horizontal piping.

D. Supports for copper tubing:
   1. The following maximum horizontal spacing and minimum rod diameters:
      a. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
      b. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
      c. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
      d. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
      e. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
      f. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
      g. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod
   2. Install supports for vertical copper tubing every 10 feet (3 m).
   3. Support vertical piping and tubing at base and at each floor.

E. Supports for steel piping:

1. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
   e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
   f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
   g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
   h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
2. Install supports for vertical steel piping every 15 feet (4.5 m).
3. Support vertical piping and tubing at base and at each floor.

F. Supports for stainless-steel piping:
1. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
   e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
   f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
   g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
   h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
2. Install supports for vertical steel piping every 15 feet (4.5 m).
3. Support vertical piping and tubing at base and at each floor.

G. Supports for CPVC piping:
1. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
   b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
   c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
   d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
   e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
   f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
2. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
3. Support vertical piping and tubing at base and at each floor.

H. Supports for PEX tubing:
1. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

a. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod. Or
b. ¾" and smaller: 72 inches when a continuous support channel is used.
c. 1" and larger: 96 inches when a continuous support channel is used.

2. Support vertical piping and tubing at base and at each floor.
3. Install hangers for vertical PEX piping every 48 inches (1200 mm).
4. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.

I. Supports for PVC piping:
1. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
a. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
b. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
c. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
d. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
e. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
2. Install supports for vertical PVC piping every 48 inches (1200 mm).
3. Support vertical piping and tubing at base and at each floor.

J. Supports for insulated piping:
1. Attach clamps and spacers to piping.
a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
4. Shield Dimensions for Pipe: Not less than the following:
a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

K. Supports for Vertical-Piping

1. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   a. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
   b. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

L. Design hangers for pipe movement without disengagement of supported pipe.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation.

N. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries, such as grade beam, basement wall, sump wall etc.: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.

E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.

F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.

D. Fire Rated Surface:
   1. Seal opening at floor and wall as follows:
      a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
      b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
      c. Pack void with backing material.
      d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

E. Non-Rated Surfaces:
   1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
      a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
      b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
      c. Install type of sealant or caulk suitable for application.
   2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
   3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 22 05 29

SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Review these documents for coordination with additional requirements and information that apply to work under this Section.

C. 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

D. 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

E. 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

F. 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

G. 22 20 23 – GAS PIPING

1.2 SUMMARY

A. It is the intent of this Section to provide vibration isolation supports for all equipment and piping as it may be required to prevent transmission of vibration to the building structure. It shall be the Contractor's responsibility to select and install vibration isolators which shall meet the specified noise criteria standards to the extent that the noise can be controlled by the vibration isolators.

1.3 REFERENCES

A. International Code Council (IBC) "International Building Code"

1.4 PERFORMANCE REQUIREMENTS

A. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.

B. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of one-half (0.5) horsepower and larger. Deflections as tabulated are minimums and it shall be the vibration isolator manufacturer's responsibility to determine the amount of spring deflection required for each isolator to achieve optimal performance in preventing transmission of objectionable vibrations and in meeting the noise criteria standards referenced herein.

C. Unless otherwise noted, equipment driven by motors one-quarter (0.25) horsepower and smaller shall be isolated by means of type "ND" elastomeric mounts or type "HD" elastomeric hangers properly sized for seven-twentieths (0.35) inch deflection.

D. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and antioxidant additives.

E. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts, and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

F. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of thirty (30) pounds per square foot. Wind loads shall be applied to all exposed surfaces of the isolated equipment to identify worst-case scenario loads.

G. All spring isolators shall be completely stable in operation and shall be designed for not less than fifty (50) percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a K_x and K_y anisotropic ratio of at least 1:1.

H. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory-certified data. Any variance or non-compliance with these Specification requirements shall be corrected by the Contractor at no additional cost to the Owner. The manufacturer may purchase other manufactured products to meet this Specification and shall guarantee outsourced products as a single point of responsibility. Outsourced products shall be identified as such in the submittal for approval.

I. The Contactor and manufacturer of the isolation devices and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.

J. Deflection information is based on maintaining rooms at the following maximum sound levels, denominated in Noise Criteria (NC) as defined by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the American National Standards Institute (ANSI) S1.8 “Reference Values for Levels used in Acoustics and Vibrations” requirements.

RECOMMENDED NOISE CRITERION			
CATEGORY	**TYPE OF ROOM**	**NOISE CRITERION LEVEL**	**EQUIVALENT SOUND LEVEL**
		NC	*dB_A*
Offices	Conference rooms	25 – 30	35 – 40
Offices	Private	30 – 35	40 – 45
Offices	Open-plan areas	35 – 40	45 – 50
Offices	Business machines, computers	40 – 45	50 – 55
Offices	Circulation	35 – 40	45 – 50
Schools	Lecture and classrooms	25 – 30	35 – 40
Schools	Open-plan classrooms	35 – 40	45 – 50
Libraries	Libraries	35 – 40	40 – 50
Theaters	Theater	20 – 25	30 – 35
Theaters	Stage house	20 – 25	30 – 35
Theaters	Trap room	20 – 25	30 – 35
Theaters	Orchestra pit	20 – 25	30 – 35
Theaters	Rehearsal rooms	20 – 25	30 – 35
Theaters	Teaching studios	25 – 30	35 – 40
Theaters	Practice rooms	25 – 30	35 – 40
Theaters	Ensemble rooms	25 – 30	35 – 40
Theaters	Set shop	40 – 45	50 – 55

1.5 SUBMITTALS

A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.

B. Shop drawings: indicate inertia bases and locate vibration isolators with static and dynamic loads annotated on each instance. Indicate assembly, materials, thicknesses, dimensional data, layouts, and connection details. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

C. Product data:

1. Submit schedule of vibration isolator types with locations and loads on each instance. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.

D. Submit calculations of the design data indicating maximum room sound levels are not exceeded.

E. Submit special procedures as required by the manufacturer's installation instructions. Indicate installation requirements maintaining integrity of sound isolation.

F. Submit manufacturer's certificate indicating the submitted products meet or exceed the specified requirements.

G. Submit manufacturer's field reports indicating results of inspection by the manufacturer's designated representative.

H. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.6 QUALITY ASSURANCE

A. Testing agency qualifications: independent agency with the experience and capability to conduct the testing indicated. Agency shall be certified as a Nationally Recognized Test Laboratory (NTRL) as defined by Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910.7 "Definition and Requirements for a Nationally Recognized Testing Laboratory" as well as certified by the local authorities having jurisdiction.

B. Welding qualifications: qualify procedures and personnel according to American Welding Society (AWS) D1.1/D1.1M "Structural Welding Code – Steel" requirements.

C. All plumbing systems' vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

PART 2 – PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

A. All vibration isolators described in this Section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Section 22 05 48.13, Subsection 1.4 "PERFORMANCE REQUIREMENTS" and the information below.

B. Acceptable manufacturers:

1. VMC/Amber Booth
2. Mason Industries
3. Kinetics Noise Control
4. Vibration Eliminator Company

C. Type “WSW”

1. Two (2) layers of three-eighths (0.375) inch thick neoprene pad consisting of square waffle modules separated horizontally by a sixteen (16) gauge galvanized shim. Where the load bearing area of the equipment is not the same size and shape as the load bearing area of the pad and load distribution plates, a galvanized steel sheet of one-quarter (0.25) inch minimum thickness shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of three twenty-fifths (0.12) inch up to four twenty-fifths (0.16) inch.

D. Type “ND”

1. Neoprene mountings shall have minimum static deflection of seven-twentieths (0.35) inch. All metal surfaces shall be neoprene covered and have friction pads at both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment, such as small vent sets, to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size and shape as the load bearing area of the pad and load distribution plates, a galvanized steel sheet of one-quarter (0.25) inch minimum thickness shall be utilized to ensure the load bearing capacity of the pad is maximized.

E. Type “SLF”

1. Spring isolators shall be free-standing and laterally stable without any housing and complete with a molded neoprene cup or one-quarter (0.25) inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed height and operating height shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than four-fifths (0.8). Springs shall have minimum additional travel to solid equal to fifty (50) percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height, and solid spring height.

F. Type “SLR”

1. Restrained spring mountings shall have an “SLF” mounting as described in Subsection 2.1.E “Type ‘SLF’” and within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed height and operating height shall be equal. A minimum clearance of one-half (0.5) inch shall be maintained around restraining bolts and between the housing and the spring to avoid interference with any spring action. Limit stops shall be out of contact during normal operation. Since housings are bolted or

welded in position under outdoor equipment, there shall be an internal isolation pad in addition to the friction pad on the bottom.

G. Type “HD”

1. Hangers shall consist of rigid steel frames containing a minimum one and one-quarter (1.25) inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. To maintain stability, the boxes shall not be articulated as clevis hangers.

H. Type “30N”

1. Hangers shall consist of rigid steel frames containing a minimum one and one-quarter (1.25) inch thick neoprene element at the top and a steel spring as described in Subsection 2.1.E “Type ‘SLF’” and seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene molded bushings projecting through the steel box. To maintain stability, the boxes shall not be articulated as clevis hangers, nor shall the neoprene element be stacked on top of the spring. Spring and hanger lower hole diameters shall be large enough to permit the hanger rod to swing through a thirty (30) degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the thirty (30) degree arc capability.

I. Type “PC30N”

1. Hangers shall be as described in Subsection 2.1.H “Type ‘30N’” but shall be pre-compressed and locked at the rated deflection by means of a resilient seismic up stop to keep piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a hanger drawing showing the thirty (30) degree capability.

J. Type “WBI/WBD”

1. Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup as described in Subsection 2.1.E “Type ‘SLF’” and with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be present for thrust at the factory and adjusted in the field to allow for a maximum of one-quarter (0.25) inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached to the centerline of thrust and symmetrical on either side of the unit.

K. Type “SLR-MT”

1. Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable and flexible nylon (Kevlar) reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of three (3) hertz. Air springs shall be designed for a burst pressure that is a minimum of three (3) times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed.

The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed height and operating height shall be equal. A minimum clearance of one-half (0.5) inch shall be maintained around restraining bolts and between the housing and air springs to avoid interference with any air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three (3) leveling valves to maintain level within plus or minus one-eighth (0.125) inch. Air spring mounts shall be located between the supporting steel and the roof, or the grillage and dunnage as shown on the Drawings when there is no provision for direct mounting. Submittals shall include natural frequency and tests for load and damping performed by an independent lab or acoustician.

2.2 BASES

A. Type “WF”

1. Welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be “T” or “L” shaped. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to one-tenth (1/10) of the longest dimension of the base. Base depth need not exceed fourteen (14) inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to maintain a one (1) inch operating clearance under the base.

B. Type “ICS”

1. Vibration isolation manufacturer shall provide steel members welded to height savings brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent distortion and misalignment of equipment.

C. Type “RBMK”

1. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, steel formed bases, and sheet metal formed bases shall not be acceptable. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. Bases may be “T” or “L” shaped where space is a problem. Bases shall be a minimum of one-twelfth (1/12) of the longest dimension of the base but not less than six (6) inches. Base depth need not exceed twelve (12) inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include concrete reinforcement consisting of bars that are a minimum of one-half (0.5) inch and welded in place on six (6) inch centers, running both ways in a layer of one and one-half (1.5) inch above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height saving brackets shall be employed in all mounting locations to maintain a one (1) inch operating clearance under the base.

2.3 FLEXIBLE PIPE CONNECTIONS

A. Type “SFDEJ,” “SFEJ,” “SFDCR,” “SFU,” and “CR” (control rods):

1. Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions shall have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out.

2. Flexible cable wire shall not be acceptable.

3. Sizes one and one-half (1.5) inch through fourteen (14) inches shall have a ductile iron external ring between the two spheres.

4. Sizes sixteen (16) inches through twenty-four (24) inches may be a single sphere.

5. Sizes three-quarters (0.75) inch through two (2) inches may be a single sphere, bolted threaded flange assemblies and cable retention.

6. Minimum ratings through fourteen (14) inches shall be two hundred and fifty (250) PSI at one hundred and seventy (170) degrees Fahrenheit and two hundred and fifteen (215) PSI at two hundred and fifty (250) degrees Fahrenheit.

7. Minimum ratings for sixteen (16) inches through twenty-four (24) inches shall be one hundred and eighty (180) PSI at one hundred and seventy (170) degrees Fahrenheit and one hundred and fifty (150) PSI at two hundred and fifty (250) degrees Fahrenheit.

8. Higher published rated connectors may be used where required.

9. Safety factors shall be a minimum of three hundred (300) percent. All expansion joints shall be factory tested to one hundred and fifty (150) percent of maximum pressure for twelve (12) minutes before shipment.

10. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing though one-half (0.5) inch thick neoprene washer bushings large enough to take the thrust at one thousand (1000) PSI of surface area may be used on unanchored piping where the manufacturer determines the conditions exceed the expansion joint rating without them.

11. Submittals shall include two (2) test reports by independent consultants showing minimum reductions of twenty (20) decibels in vibration accelerations and ten (10) decibels in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

12. All expansion joints shall be installed on the equipment side of the shut-off valves.

2.4 MECHANICAL ANCHOR BOLTS

A. Drilled-in and stud-wedge type or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength characteristics required for anchoring and as tested according to the ASTM E488 “Standard Test Methods for Strength of Anchors in Concrete Elements” requirements. The stud anchors shall have an evaluation report number from the ICC-ES verifying its allowable loads.

2.5 ADHESIVE ANCHOR BOLTS

A. Drilled-in and capsule anchor system containing polyvinyl chloride or urethane methacrylate-based resin and accelerator; or an injected polymer; or a hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength characteristics required for anchoring and as tested according to the ASTM E488 "Standard Test Methods for Strength of Anchors in Concrete Elements" and ICC-ES AC308 "Post-installed Adhesive Anchors in Concrete Elements" requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the work required.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations prior to installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING ISOLATION

A. Horizontal piping:

1. Isolate all pumped water, pumped condensate, and refrigerant piping sizes one and one-quarter (1.25) inch and larger within mechanical rooms and pipe sizes two (2) inches and larger outside mechanical rooms shall also be isolated. Outside equipment rooms, this piping shall be isolated for the greater of fifty (50) feet or one hundred (100) pipe diameters from externally isolated equipment. For the first three (3) support locations from the externally isolated equipment, provide Type "30N" hangers or Type "SLF" floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a one (1) inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping yet also permitting piping to function as a floating system. Size hangers for two hundred (200) percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.

B. Riser piping:

1. Isolate all vertical pipe risers one and one-quarter (1.25) inch and larger, where specifically shown and detailed on riser diagrams, shall be fully supported by Type "SLF" mounts with precompression plates and brackets. Refer to manufacturer's details for additional information. Steel spring deflection shall be three-quarters (0.75) inch minimum. In locations where added deflection is required due to pipe expansion and contraction, the spring deflection shall be a minimum of four (4) times the anticipated movement to prevent binding. Provide Type "SWS" wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations shall show anticipated expansion and contraction at each support point, initial and final loads on the build structure, and spring deflection changes. Submittal data shall include

certification that the piping system has been examined for excessive stresses and that none exist in the proposed design.

3.3 INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points as well as with requirements for concrete reinforcement and formwork as specified in Division 03.

B. Installation of vibration isolators shall not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Locate isolation hangers as near to the overhead support structure as possible.

D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below the base is provided when supported equipment has been installed and loaded for operation.

F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.

G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and ensure that units are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices, if any, intended for temporary protection against overloading during installation or shipment.

H. Install cables so they do not bend across edges of adjacent equipment or building structure.

I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

J. Install bushing assemblies for anchor bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to walls.

K. If specific attachment to structure is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

L. Drilled-in anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical conduit, telecommunications conduit, and gas lines.

2. Drilling holes in concrete or masonry prior to concrete, mortar, or grout achieving full design strength shall not be acceptable.

3. At wedge anchors, protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with the sleeve fully engaged in the structural element to which the anchor is to be fastened.

4. At adhesive anchors, clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes beginning at the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Engage a qualified testing agency to perform tests and inspections. Coordinate with the Owner, through the Architect, for additional requirements prior to engaging the test.

B. Perform tests and inspections as required and as indicated below:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to the authorities having jurisdiction.

2. Schedule test with the Owner, through the Architect, prior to connecting anchorage devices to restrained components (unless post-connection testing has been approved) and with at least seven (7) days of advance notice.

3. Obtain the Architect's approval prior to transmitting test loads to structure. Provide temporary load-spreading members.

4. Test a minimum of four (4) installed anchors and fasteners of each type and size as selected by the Architect. Provide additional testing of more anchors if instructed by the Owner or Architect.

5. Test to ninety (90) percent of the rated proof load of device.

6. Measure isolator restraint clearance and isolator deflection.

7. Verify snubber minimum clearances.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops to they are out of contact during normal operation.

END OF SECTION 22 05 48.13

SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. It is the intent of this Section to provide requirements for commissioning of plumbing systems, subsystems, and equipment. This Section supplements the general requirements specified in Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS.

B. Refer to Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

C. The requirements of this Section shall apply to all Sections of Division 22.

D. This project shall have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor shall be responsible for executing, is defined in Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) shall be appointed by the Owner or the Owner's representative.

E. Refer to Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS for definitions and additional information.

1.3 REFERENCES

A. Division 01 Specification Sections

B. 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

C. 01 33 00 – SUBMITTAL PROCEDURES

1.4 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel in accordance with the requirements of Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS and of Division 22, is required in cooperation with the Owner and the CxA.

B. The plumbing systems commissioning will include the systems listed in Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS.

1.5 SUBMITTALS

A. The commissioning process requires review of selected submittals. The CxA shall provide a list of submittals that shall be reviewed by the CxA. This list shall be reviewed and approved by the Owner prior to forwarding to the Contractor. Refer to Section 01 33 00 – SUBMITTAL PROCEDURES for further details.

B. The commissioning process requires review of submittals simultaneously with engineering review. Specific submittal requirements related to the commissioning process are as specified in Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS.

PART 2 – PRODUCTS (N/A)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of the building plumbing systems shall require inspection of individual elements of the plumbing construction throughout the construction period. The Contractor shall coordinate with the CxA in accordance with Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS and the commissioning plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete pre-functional checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for systems functional performance testing. The CxA will prepare pre-functional checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Owner and to the CxA for review. The CxA may spot check a sample of completed checklists. If the CxA determines that the information provided on the checklists is not accurate, the CxA will return the checklist with markups to the Contractor for correction and resubmission. If the CxA determines that a significant number of completed checklists for similar equipment are not accurate, the CxA will select a broader sample of checklists for review. If the CxA determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for pre-functional checklists, equipment startup reports, and other commissioning documents.

3.3 CONTRACTOR TESTS

A. Contractor tests, as required by other Sections of Division 22, shall be scheduled and documented in accordance with Division 01. All testing shall be incorporated into the project schedule. The Contractor shall provide no less than seven (7) days of advance notice of testing. The CxA will witness selected Contractor tests at the sole discretion of the CxA. Contractor tests shall be completed prior to scheduling systems functional performance testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. The commissioning process includes systems functional performance testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and to test system performance under emergency conditions. The CxA will prepare detailed systems functional performance test procedures for review and approval by the Engineer. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The CxA will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. Refer to Section 01 91 13 – GENERAL COMMISIONING REQUIREMENTS for additional information.

3.5 TRAINING OF OWNER PERSONNEL

A. Training of the Owner's operation and maintenance personnel shall be required in cooperation with the Engineer and CxA. Provide competent, factory-authorized personnel to provide instruction to the operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS. The instruction shall be scheduled in coordination with the Engineer after submission and approval of formal training plans. Refer to Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS and Sections of Division 22 for additional Contractor training requirements.

END OF SECTION 22 08 00

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

A. Provide a complete domestic water piping system.

B. Provide pressure gauge with all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, and leave in safe and proper operating condition all systems.

C. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.4 SUBMITTALS

A. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories.
   2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
   3. Gauge: Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and manufacturer instruction.
   4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.7 EXTRA MATERIALS

A. Furnish two (2) packing kits for each size valve and two (2) loose keys for outside hydrants.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Products and materials listed herein are for references of approved materials.

B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 WATER PIPING, BELOW GRADE

A. Copper Tubing: ASTM B88, Type K.
   1. Fittings: ASME B16.22 wrought copper and bronze.
   2. Joints: AWS A5.8, BCuP silver braze.

B. PEX-a Tubing: ASTM F876/F877, AWWA C904
   1. Fittings: ASTM F1960 engineered polymer and lead-free brass.
   2. Joints: ASTM F1960 cold expansion with PEX reinforcing ring.

2.3 WATER PIPING, ABOVE GRADE

A. Copper Tubing 6” and smaller: ASTM B88, Type L hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints:
      a. Solder, lead free, ASTM B32, 95-5TA (tin-antimony), or tin and silver, with melting range 430 to 535 degrees F. [Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.]
      b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
      c. Appurtenances for Grooved-End Copper Tubing:
         1) Manufacturers: Subject to compliance with requirements, provide products from the following or approved equal:
            a) Victaulic
         2) Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
         3) Mechanical Couplings for Grooved-End Copper Tubing (2” copper and larger):
            a) Copper-tube dimensions and design similar to AWWA C606.
            b) Ferrous housing sections.
            c) EPDM-rubber gaskets suitable for hot and cold water.
            d) Bolts and nuts.
            e) Minimum Pressure Rating: 300 psig.
   3. At the contractor’s option, Press connection copper fittings manufactured by an approved manufacturer or approved equal will be acceptable. Building services piping –20 degrees to +250 degrees up to 200 PSI. Fittings shall comply with NSF-61, CSA, UPC. Seals shall be made of EPDM material and manufactured with an inboard bead design. The fittings shall include the Smart Connect feature to identify unpressed connections during system testing. All fittings shall

be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes.

a. Approved manufacturer(s):
   1) Nibco
   2) Viega

B. CPVC: Pipe and fittings shall be manufactured from virgin rigid CPVC (chlorinated polyvinyl chloride) vinyl compounds with a cell class per ASTM D 1784 and listed by ICC to ASTM E84, similar to SPEARS EVERTUFF CTS or approved equal.
   1. Pipe & Fittings = ASTM D 2846. All pipe and fittings shall be manufactured in the United States and shall conform to National Sanitation Foundation (NSF) Standards 14 and 61.
   2. Joints = ASTM F 493, solvent cements for CPVC pipe and fittings.
   3. Installations = Comply with the latest installation instructions published by manufacturer and shall conform to all applicable plumbing, fire and building code requirements. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized-vinyl products or other aggressive chemical agents not compatible with CPVC compounds.
   4. The system shall be hydrostatically tested after installation.

C. Do not allow all-thread pipe nipples in any piping system

2.4 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size two (2) inches and Smaller:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
   2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Pipe Size 2-1/2 inches and Larger:
   1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets (Victaulic split ring flange is not allowed).
   2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
   3. PEX-a tube and pipe: Class 150 ASME B16.5 flanges; ASTM F1960 joints.

2.5 GALVANIC PROTECTION

A. Dissimilar piping material connections shall not be made without an approved dielectric union.

B. Dielectric Connections:
   1. Two (2) inches and smaller union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier. Provide Watts Series LF3001A or an approved equal.
   2. 2-1/2 inches and larger, forged steel flanges, screwed neck, 1/16 inch thick preformed neoprene gasket.

2.6 VALVES

A. General
   1. Valves shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified.
   2. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, shock absorbers,

equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. No access panels will be permitted in public spaces with gypsum ceilings.

B. Ball Valves:
1. Manufacturers:
   a. NIBCO INC.
   b. Keystone
2. Two (2) inches and Smaller: Nibco S/T-585-66-LF, full-port, MSS SP 110, Class 150, 600 psi CWP, silicon bronze, two piece body, chrome plated silicon bronze ball, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends. No Lead.
3. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive CPVC material that meets UL 2043 approved for inside air plenum. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.
4. Ball valves installed outdoors or in-ground shall have stainless steel handle.
5. Ball Valves for PEX-a Two (2) inches and smaller: NSF 359, Class 150, 250 psi CWP, forged brass, two piece body, brass ball, Teflon (PTFE) seats, blow-out proof stem, lever handle, ASTM F1960 ends. No Lead. Basis of design Uponor Lead-free Commercial Ball Valves.
6. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
7. Provide memory stops on all ball valves installed in domestic hot water return lines. Memory stops shall be adjustable after pipe insulation is applied.

C. Shut-off Valves:
1. Manufacturers:
   a. NIBCO INC.
   b. Milwaukee.
   c. Apollo.
2. Line Shut-Off Valves 2-1/2” to 3” where system operating pressure will not exceed 300 p.s.i.g. shall be 300 WOG LEAD-FREE ductile iron body with non-rising stem, ductile iron wheel handle, bronze stem and flange ends. Acceptable valves are Nibco F-619-RWS, or approved equivalent model by Kitz, Bray, Milwaukee, or Apollo.
3. Line Shut-Off Valves 4” and larger where system operating pressure will not exceed 300 p.s.i.g. shall be 300 CWP ductile iron body gate valve with non rising stem, resilient wedge, flange ends, EPDM liner and seal. Acceptable valves are NIBCO Model F-619-RWS/SON, or approved equal.
4. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
5. Install valves with stems upright or horizontal.

D. Spring Loaded In-Line Check Valves:
1. Manufacturers:
   a. NIBCO INC.
   b. Watts
2. Two (2) inches and Smaller: Nibco S-480-LF Series, class 125, MSS SP 80, silicon bronze body, stainless steel and PTFE disc, and soldered ends. No Lead.
3. 2-1/2 inches and Larger: NIBCO INC. F908-SS Series, MSS SP 71, cast iron body, stainless steel fitted, stainless steel disc, flanged ends. No Lead.

E. Balancing Valves (Hot Water Recirculation)
1. Balancing valves shall be venturi orifice type, bronze or brass body with brass or chrome ball, a minimum of two differential pressure read-out ports, 300 psi maximum working pressure. A compatible positive shutoff ball valve with memory stop is to be provided if not included with the balancing valve assembly.
2. Balancing valves shall be IMI Flow Design model UA Zero series (0.5 to 1.5 GPM venturi range) or approved equal by ITT or Bell and Gossett. Provide extended handle as required.
3. Ball valves are not acceptable for balancing the hot water return system.

2.7 STRAINERS

A. Manufacturer: Watts, Crane or approved equal.

B. Two (2) inches and Smaller: Threaded (lead free) cast copper silicon alloy for 400 PSI WOG, wye pattern with 1/32 inch stainless steel perforated screen. Watts Series LF777.

C. 2-1/2 and Larger: Class 125, flanged (lead free) cast iron strainer for 200 PSI WOG, wye pattern with 1/16-inch stainless steel perforated screen. Watts Series 77F-DI-125.

D. Lead Free.

2.8 GAGES AND TAPS

A. Manufacturers: For portable water system (Lead Free)
1. Weiss
2. Marsh Bellofram
3. Weksler
4. Dwyer

B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Stainless steel.
2. Bourdon Tube: Phosphor bronze.
3. Dial Size: 4-1/2 diameter.
4. Mid-Scale Accuracy: One (1) percent.
5. Scale: Psi.

C. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.

D. Ball Valve: Brass 1/4 inch NPT for 250 psi.

E. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.

F. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection size, location, and invert are as indicated on Drawings.

B. Establish elevations of buried piping with not less than two (2) feet of cover.

C. Establish minimum separation from other services piping in accordance with code.

D. Remove scale and dirt on inside of piping before assembly.

E. Install pipe on prepared bedding.

F. Route pipe in straight line.

G. Install pipe to allow for expansion and contraction without stressing pipe or joints.

H. Do not use lead bearing solder materials.

I. Pipe Cover and Backfilling:
   1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
   2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
   3. Do not use wheeled or tracked vehicles for tamping.

J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

A. Insulate all piping installed in exterior walls, above food service areas, and any area exposed to temperatures below 40 degrees Fahrenheit.

B. Install non-conducting dielectric connections wherever jointing dissimilar metals.

C. Insulate all domestic hot water supply and return lines.

D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

G. Provide expansion tank for each domestic water heater, install per manufacturer's recommendations.

H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.

I. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.

J. Establish elevations of buried piping outside the building to obtain not less than one (1) foot of cover.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Install water piping in accordance with ASME B31.9.

M. Sleeve pipes passing through partitions, walls and floors.

N. Install unions downstream of valves and at equipment or apparatus connections.

O. Install valves with stems upright or horizontal, not inverted.

P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

Q. Install ball valves for shut-off and to isolate equipment at branch to each fixture bank and at each plumbing appliance or water heater.

R. Provide check valves on discharge of all water circulating pumps.

S. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.

T. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.

U. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all equipment with solenoid valves.

V. Route all domestic water piping inside building in climate controlled space not subject to freezing.

W. Do not use lead bearing solder materials.

X. 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.

Y. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following.

Z. Press-Connect Joints for Copper Tubing: Join copper tube and press-connect fittings with tools recommended by fitting manufacturer. Contractor installer shall be certified by the manufacturer.

AA. Lead Free.

BB. Locate valves within 18” of ceiling so that they are within reach

CC. Insulate entire wall hydrant box, valve and piping in exterior walls.

DD. Provide drain valves at main shut off valves and low points of piping and apparatus so the system can be entirely drained.

EE. Provide manual air vents at high and low points and at any other air pockets of closed circulating pipe systems.

3.5 INSTALLATION - SERVICE CONNECTIONS

A. At each incoming water service line provide approved reduced pressure back-flow preventer. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.

B. Provide a cast iron sleeve around service main to six (6) inches above floor and six (6) inches minimum below grade beam. Size for minimum of two (2) inches of loose batt insulation stuffing.

C. Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.

3.6 INSTALLATION - BACKFLOW PREVENTERS

A. Provide at each make up connection to a hot water boiler, cooling tower, chilled water system, kitchen equipment, and at each piece of equipment requiring a make-up connection.

B. Provide at water supply to fire protection system.

C. Provide a floor drain within six (6) feet of each backflow preventer.

D. Backflow preventer shall be certified by Contractor.

E. Lead Free.

3.7 INSTALLATION – PRESSURE GAGES

A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.

B. Install gage taps in piping with isolation valves.

C. Install pressure gages at main water entry. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install gage in piping to each inlet and outlet of water heater.

E. Install gage in piping to each end of backflow preventer.

F. Install gage in piping to each end of double check valves.

G. Install gage in piping to each inlet and outlet of water softener.

H. Install gage in piping to each inlet of water filter.

I. Install gage in piping to each inlet of commercial dishwasher machine.

3.8 DOMESTIC HOT WATER SYSTEM BALANCING

A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.

B. Preparation of the hot water system for balancing:

1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
2. Verify recirculation pump operation and rotation.
3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.

C. The test and balance report shall indicate the following:

1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
2. Pressure, temperature and flow in gpm at the suction side of each recirculating pump.

D. Copies of the final approved balancing report are to be included in the O and M manuals as noted in “Permits” under Part 1 of Section 22 05 00.

3.9 FIELD QUALITY CONTROL

A. Pressure test all domestic water piping.

B. After installation and prior to backfill or cover-up, rinse piping system of particulate contaminants, cap and subject to static water pressure of 125 psig for four (4) hours.

C. Repair leaks and defects and re-test any portion of piping system that fails.

D. Provide written test report including date and time of test, pass or fail indication, summary of remedial work required and date and time of each re-test.

E. Installers for PEX-a piping shall have completed the applicable training courses per manufacturer’s requirements.

F. Cleaning of piping systems:
1. General cleaning of piping systems: Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge, and circulate.
2. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only.
3. Phase One: Initial flushing of system.
   a. Remove loose dirt, mill scale, weld beads, rust and other deleterious substance without damage to system components. Open valves, drains,

vents and strainers at all system levels during flushing procedures. Flush until “potable water clear” and particles larger than 5 microns are removed.

b. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.

4. Phase Two: Cleaning of Piping Systems:
   a. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing.
   b. Flush system and replace with clean water.
5. Phase Three: Final flushing and rinsing:
   a. Flush and rinse until “potable water clear” and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
6. Submit status reports upon completion of each phase of work on each system.

G. Branch Connections:
   1. Pipe 2” and smaller. For threaded piping, use straight size reducing tee. When branch is small than header, a nipple and reducing coupling or swagged nipple may be used.

H. 2-1/2” through 36”. For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

I. See section 220500 for additional requirements.

END OF SECTION 22 11 16

SECTION 22 11 23 - DOMESTIC WATER PRESSURE BOOSTER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General 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.

C. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING

D. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

E. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

F. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all mechanical systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.3 STANDARDS

A. The domestic water pressure booster system shall conform to all ordinances and regulations of the City, County, State and/or other authorities having jurisdiction in accordance with the requirements of the following codes, standards and design guides:

1. The Uniform Plumbing Code, 2021 Edition, with most current State of Texas Amendments
2. The International Building Code, 2021 Edition, with most current State of Texas Amendments
3. UL Listing - All motors, controllers and electrical components shall carry a UL Approval for the assembly.

4. NEMA Compliance - All controllers shall be designed in accordance with the specified NEMA requirements.
5. ANSI/NSF 61 compliance is required for all components of the domestic water system.

1.4 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of this work and pay all charges incident thereto. He shall deliver to the Architect all certificates of said inspection.

1.5 EQUIPMENT, MATERIAL BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products. Proposed alternate equipment and materials may be submitted along with the "base" products, provided deductive pricing is included with the alternate.

C. Alternate "approved equal" items listed shall conform to specified base items and shall be substantially equal in quality, size, weight, construction and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation and other information available to him, and shall approve or disapprove any alternates. The decision of the Engineer shall in all cases be final.

D. The Contractor shall coordinate the installation of all equipment proposed for use in this project with all building trades (architectural, structural, and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.6 SUBMITTALS

A. Shop drawings shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any deviations from specified equipment shall be clearly indicated on the submittal.

B. Included with shop drawings of mechanical equipment requiring electrical connections shall be a written statement confirming coordination of voltage requirements, bearing the names and signatures of the mechanical and electrical contractors. A photocopied reproduction of the below statement is acceptable.

C. Submittal shall include pump curves with selection point clearly identified and wiring diagrams for all electrical components.

D. See additional requirements in section 22 05 00.

1.7 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of three (3) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

1.8 QUALITY ASSURANCE

A. The Domestic water Booster system manufacturer shall have an extensive background and experience in the design and fabrication of Domestic Booster systems.

B. The manufacturer shall have fabricated Domestic water Booster systems for a minimum of ten (10) years.

C. The manufacturer shall provide single source responsibility for complete package. The entire package shall be third party certified by:

1. Underwriters Laboratories Inc.
2. The International Association of Plumbing and Mechanical Officials
3. NSF 372 for compliance to Low Lead Content law

D. Installer's Qualifications: The system shall be installed by a firm having minimum three years experience regularly engaged in the installation of variable speed domestic booster pump systems.

E. Certification shall obtained by the manufacturer indicating that the function and performance characteristics of all products and materials have been determined by testing and ongoing surveillance by an approved third-party certification agency. Assertion of certification shall be in the form of identification in accordance with the requirements of the third-party certification agency

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to the Project Site under provisions of Division 01 and Division 20.

B. Protect internals from entry of foreign material by temporary caps on flanged openings.

C. Store pumps in a dry location. Retain shipping flange, protective covers and protective coatings during storage. Protect bearings and couplings against damage from sand, grit and other foreign matter. Comply with manufacturers' rigging instructions for handling.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pressure ratings of pumps, pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the anticipated system pressures in which they are installed.

B. The Contractor shall ascertain for himself the space and access available for the installation of a factory assembled packaged unit and as an option may assemble the various components in place at the Site in lieu of providing a factory assembled unit. However, all components of the system shall be compatible and be furnished by a single source manufacturer and all electrical services and interconnecting equipment wiring must be provided for within this Contractors bid.

C. The booster system shall be factory assembled on a steel skid including pumps, motors, valves, Type "L" copper or Schedule 40 300 series stainless steel suction and discharge manifolds, all interconnecting piping, wiring, variable frequency drives with logic and power controls.

D. Over pressurization of the system while operating across-the-line shall be prevented by a pilot operated diaphragm type combination pressure regulating and non-slam check valve on each pump. Main valve and cover shall be ductile iron with a fused epoxy coating and stainless steel stem and cover bolts. Construction shall be suitable for the maximum working pressure of the system.

E. All pilot lights and visual indicators shall be illuminated from the rear by long life LED lamps. Neon and incandescent lamps are not acceptable.

F. Provide isolation valves on the suction and discharge of each pump. The isolation valves shall be 600 WOG full-port ball valves (2" and smaller) and lug style butterfly valves (2½ “ and larger).

G. Provide two 4 1/2" ASME grade A, panel mounted gauges for indicating system suction and system discharge pressure.

H. All skid-mounted components shall be factory finished in high quality epoxy or enamel paint. The base shall be suitable for grouting.

I. The packaged pumping system shall include all electrical wiring between components and shall be completed and tested at the factory prior to shipment.

J. Unions or flanges shall be provided for easy removal of pumps. Pipe headers shall be sized for a velocity not exceeding 7-1/2 FPS and shall be terminated with a groove joint capable of accepting a groove coupling or groove flange furnished by Contractor.

K. System shall be arranged such that single point connections are required for piping and electrical power supply.

L. Individual pumps, motors and pressure regulating or check valves shall be serviceable with the booster system in operation.

M. All similar components shall be of one manufacturer, (i.e., valves, gauges, etc.).

N. Refer to schedules on Contract Drawings for required pump capacities and electrical characteristics.

2.2 DOMESTIC WATER PRESSURE BOOSTER SYSTEM

A. Furnish and install a factory fabricated vertical or horizontal mounted duplex pressure booster system. The system shall be capable of the capacity and flow rate as indicated on the Drawings.

B. Pumps and Motor

1. Pumps shall be variable speed horizontal or vertical multi-stage equipped with stainless steel shaft and impeller and sleeve mounted mechanical shaft seal.
2. Each close-coupled pump motor shall be TEFC and of the energy efficient type and shall meet NEMA standards and operate within the available service factor at any point on the pump capacity head curve.
3. Motors shall be high efficiency and balanced to a maximum vibration amplitude of .001". Motors shall have ball bearings and operate at 40° ambient. Each motor shall be equipped with the manufacturer's nameplate and shall have a sufficient horsepower rating to operate the pump at any point on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor, regardless of service factor. The motor shall have a service factor of 1.15 for variations in voltage and frequency.
4. Each pump shall be provided with an individual temperature probe and purge valve having adjustable high temperature set point and differential to sense heat buildup in the pump casing. On sensing high temperature the probe circuit shall open a solenoid valve that allows the heated water to flow out.
5. All pumps shall be provided with VFD drives.
6. All operation controls for pump is under BAS Division 23.

C. Variable Frequency Drives

1. Provide and mount on the system skid [single] variable frequency drives of the PWM design suitable for variable torque applications using any standard NEMA Design B squirrel cage induction motor. Variable frequency drives shall sized for the maximum possible amp draw throughout the programmed sequence of pump operation.

2. The efficiency at full load and full speed shall be 97% with a fundamental power factor of .98.

3. Drives shall be pulse width modulated, start into a rotating load, follow signal from logic section of control panel when in auto mode and be provided with the following features:

   a. Hand/off/auto switch and manual speed adjustment.
   b. Auto Drive Shutdown for electrical fault.
   c. Automatic restart after power fails shutdown.
   d. Provide complete service diagnostics with fault history log.

4. Keypad Operator Device including the following:

   a. 2 Line Backlit LCD Display.

b. Power On and Alarm/Fault Displays.

5. Operational data displays include:

a. Drive Speed (HZ)
b. Motor Power
c. Energy (kWh)
d. Current
e. Elapsed Time
f. RPM
g. Motor Voltage

D. Pump Sequencing

1. The pump designated as the lead pump shall start following a 5 second On-Delay time after sensing a drop in the system pressure 5 PSI below the desired set point value
2. The pump controller shall compare a signal from the discharge pressure transducer to the set point value and the lead pump speed shall ramp up in order to satisfy the set point pressure.
3. The lag pump shall start following a 60 second On-Delay time, when the lead pump exceeds its best operating point (BOP), and a minimum run timer shall ensure that the lag pump runs for a minimum of 60 seconds.
4. The lag pump shall ramp down in speed and turn off when the pumps that are running are operating at a point below the BOP and the lag pump minimum run timer has expired.
5. The lead pump shall continue to operate and meet system requirements based on the set point value.
6. The lead pump shall alternate every 24 hrs of operation where the second pump shall start and run for a period of 5 seconds, both pumps shall operate, the first pump on shall ramp down and the new lead pump shall continue to operate as above to meet system requirements

E. Lead pump shutdown controls

1. All systems are equipped with a 'No-Flow' shutdown that will stop the pumps when the pump controller determines there has been a 'No-Flow' condition for a continuous 5 minute period.
2. The lead pump will start again once a drop in pressure of at least 5 psi is measured on the discharge of the system.
3. The system can be manually operated by means of the virtual Hand-off-Auto (HOA) selector buttons provided on the operator interface

F. Factory Fabrication

1. The system shall be factory fabricated complete with isolation valves on the suction and discharge of each pump. Suction and discharge manifolds are to be Type L copper or schedule 40 stainless steel. The pump assembly shall be provided with anti-vibration pads as specified below. The only field connections required will be to system headers, tank (if required), over temperature drain tube, and one incoming power connection at the control panel.
2. Provide stainless steel double sphere floating flange flexible vibration isolator complete with stainless steel control rod assemblies on the suction and discharge

headers; Kinetics Kinflex FTC series or Engineer approved equal.

3. Provide base mount free-standing unhoused spring vibration isolators with 1/4" minimum neoprene noise isolation pads, Kinetics FDS series or Engineer approved equal.
4. Provide 6" minimum thickness inertia base frame for the mounting of the booster pump, Kinetics series CIB-L or Engineer approved equal.

G. Factory Test and Certification

1. The booster system and its component parts shall undergo a complete operating flow test from zero to 100% design flow rate under the specified suction and net system pressure conditions. The system shall carry an ETL certification of testing.

H. Start-Up-Service

1. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of the booster pump assembly. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

I. Acceptable manufacturers in compliance with the specified requirements:

1. Armstrong Pumps
2. Aurora Pumps
3. Grundfos BoosterpaQ
4. Syncroflo, Inc.
5. QuantumFlo

2.3 POWER AND CONTROL PANEL

A. Assembly shall include a NEMA 12 power and control panel complete with three through the door disconnect switches, circuit breakers, magnetic starters each with 3 leg overload protection, fused control circuit transformer, automatic 24-hour alternation, low suction shutdown with visual alarm light and auxiliary contact, pump indicating lights, multiple position selector switches, control power light, low system indicating light, and lag pump start time delays. All of the above shall be factory internally pre-wired and tested in accordance with provisions of the National Electric Code. All control wires shall be individually numbered and each component shall be labeled accordingly. All internal wiring shall be copper stranded, A.W.G. with a minimum insulation of 90 degrees C. The complete assembly shall have the UL listing mark for industrial control panels.

B. Instrumentation and Emergency Controls:

1. Each system shall have panel mounted pressure gauges for indicating suction and system discharge pressure. A pre-wired and pre-piped temperature probe shall be installed in each pump and connected to a common electric purge valve for over temperature protection of pumps alarm horn with silence circuit, high system alarm with time delay, high suction shutdown with time delay, low level alarm light.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Provide pumps to operate at specified system fluid temperatures and scheduled capacities. Pumps shall operate without vapor binding and cavitations, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories. Provide no less than the minimum as required by the manufacturer.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping

D. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases.

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct bases to withstand, without damage to equipment, seismic force required by code.

3. Construct concrete bases 4 high and extend base not less than 6 inches in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.

4. Install base mounted pumps on concrete inertia base “RBMK” with spring isolators. Refer to section 22 05 00.

E. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled, split coupled vertical in-line or base mounted pumps; install supports under elbows on pump suction and discharge line sizes four (4) inches and over.

F. Provide air cock and drain connection on horizontal pump casings.

G. Provide drains for bases and seals. Route to floor drain.

H. Lubricate pumps before start-up according to manufacturer's instructions.

I. Install manual by-pass with shut-off valve where backflow prevention is provided

3.3 ALIGNMENT

A. Alignment Service shall be performed by a factory authorized direct service technician. Alignment work shall not be performed by installing mechanical contractor.

B. Comply with pump and coupling manufacturers' written instructions.

3.4 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install triple-duty valve on discharge side of pumps.

F. Install suction diffuser with stainless steel strainer and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves. Exception: do not install flexible connectors at or near split coupled vertical in-line pumps.

H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

I. All pump operation controls is under BAS Division 23.

3.5 STARTUP SERVICE

A. Start up service shall be performed by a factory authorized direct service technician. Start up work shall not be performed by installing mechanical contractor.

1. Complete installation and startup checks according to manufacturer's written instructions.

a. Check piping connections for tightness.

b. Clean strainers on suction piping.

c. Perform the following startup checks for each pump before starting:

1) Verify bearing lubrication.

2) Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

3) Verify that pump is rotating in the correct direction.

d. Prime pump by opening suction valves and closing drains, and prepare pump for operation.

e. Start motor.

f. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Demonstration shall be performed by a factory authorized direct service technician. Demonstration shall not be performed by installing mechanical contractor.

1. Train owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

2. Provide documentation of owner training in close out submittal. See additional requirements in section 22 05 00.

END OF SECTION 22 11 23

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

A. Provide a complete sanitary drainage system.

1.3 SUBMITTALS

A. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories.
   2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of equipment and clean-outs.

B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views for pumps and equipment.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the plumbing code.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.2 PIPE MATERIALS

A. Products and materials listed herein are for references of approved materials.

B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.3 SANITARY SEWER PIPING, BELOW GRADE

A. Manufacturers
   1. AB&I
   2. Charlotte Pipe and Foundry Co.
   3. Tyler Pipe/Soil Division

B. PVC Pipe
   1. Provide a complete system of solid wall schedule 40 PVC DWV piping with solvent welded joints.
   2. Solvent welded joints shall conform to IAPMO installation standards IS-9.
   3. Provide tracer wire at all under slab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled “Tracer Wire”. Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
   4. Pipe and fittings shall conform to ASTM D 1784, AST D 1785, ASTM D 2665, ASTM D 3311, and NPS standard 14 & 61.

C. Cast Iron Pipe (Hub):
   1. ASTM – A 74, hub and spigot DWV pipe and fittings with neoprene compression gasket joints for all buried pipe. Cast iron soil pipe, fittings and hub gaskets shall be manufactured by Tyler Pipe, AB & I foundry or Charlotte Pipe and Foundry. All cast iron pipe and fittings shall be of the same manufacturer.

D. Cast Iron Pipe (No Hub):
   1. ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International (first 15’-0” section of dishwasher waste grease waste pipe):
   2. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
   3. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
      a. Acceptable Manufacturers: Ideal Tridon or Husky SD-4000.

2.4 SANITARY SEWER PIPING, ABOVE GRADE

A. Manufacturers
   1. AB&I
   2. Charlotte Pipe and Foundry Co.
   3. Tyler Pipe/Soil Division

B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
   1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
      a. Acceptable Manufacturers: Ideal Tridon or Husky SD-4000.
   3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 transition coupling.

2.5 VENT PIPING, ABOVE GRADE

A. Manufacturers
   1. AB&I
   2. Charlotte Pipe and Foundry Co.
   3. Tyler Pipe/Soil Division

B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
   1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
      a. Acceptable Manufacturers: Ideal Tridon, Tyler Wide Body or Husky HD-2000.

2.6 VENT PIPING, BELOW GRADE

A. Use same as Sanitary Sewer Piping, Below Grade.

PART 3 - EXECUTION

3.2 FLOOR DRAINS

A. Provide floor drain, including sanitary waste and vent piping, where indicated on drawings and at each toilet room containing two (2) or more water closets or a combination of one (1) water closet and one (1) urinal.

B. Coordinate the exact location of all floor drains with Architectural Drawings prior to rough-in. Ensure drains are located at low points(s) of floor slope.

3.3 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Coordinate the exact location of all floor drains with architectural drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

C. Remove scale and dirt, inside and outside, before assembly.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection size, location, and invert as indicated on Drawings.

B. Establish minimum separation from other services piping in accordance with code.

C. Remove scale and dirt on the inside of piping before assembly.

D. Install with a uniform slope of not less than 1/4 of an inch per foot.

E. Install pipe on prepared bedding of bank sand, minimum of 2” depth on bottom of trench up to centerline of pipe.

F. Route pipe in straight line.

G. Excavation:
1. Excavate trenches for underground piping to the required depth to ensure two (2) foot minimum coverage over piping.
2. Cut the bottom of the trench or excavation to uniform grade.
3. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.

H. Pipe Cover and Backfilling:
1. Backfill shall not be placed until the work has been inspected, tested, and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.
2. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in eight (8) inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
3. PVC-piping shall be installed per the requirements of ASTM D 2321, which details the trench width per pipe size, bedding depth, backfill and compaction, as well as other factors. Calculating maximum burial depths for flexible piping requires the use of external loading software, additional information and free software is available at www.uni-bell.org.
4. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.

I. Disposal of excess material:
1. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by Owner/Architect.

J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.5 INSTALLATION - ABOVE GROUND PIPING

A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one (1) percent) minimum. Maintain gradients.

B. Provide and installed cleanout as required by code and local AHJ.

C. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.

D. Install a floor clean out according to the following;
   1. Not more than 40’ apart in all horizontal drain lines.
   2. At each change of direction greater than 45 Deg.
   3. At the base of each waste or soil stack.
   4. Install floor cleanouts at elevation to accommodate finished floor.
   5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
   6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines.

E. Install a wall cleanout according to the following:
   1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall
   2. Provide full size wall cleanouts at end of run and on soil stack at ganged toilets were pipes penetrate the slab including water closets, lavatories and EDF’s.

F. Install a exterior cleanout according to the following:
   1. Encase exterior cleanouts in concrete flush with grade.
   2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect.

G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

H. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

I. Install piping to maintain headroom. Do not spread piping, conserve space.

J. Group piping whenever practical at common elevations.

K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

M. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.

N. Install piping penetrating roofed areas to maintain integrity of roof assembly.

O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

P. Burred ends of all pipe and tubing shall be reamed to the bore of the pipe or tube and all chips shall be removed before installation.

Q. Install bell and spigot pipe with bell end upstream.

R. Sleeve pipes passing through partitions, walls and floors.

S. Support cast iron drainage piping at every joint.

T. Water test all piping per code.

U. Slope all vent piping to allow for drainage.

V. Provide and install a floor sink next to each HVAC air handling unit, pump, expansion tank, and every piece of HVAC equipment requiring condensate removal in every mechanical room.

W. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.

X. PVC-piping is a combustible material per ASTM E 136 and shall not be installed in return air plenums unless it is fire wrapped to meet all the requirements of ASTM E 84 test protocol with a flame spread index of 25 and a developed smoke spread of 50 or less.

3.6 RODDING SEWERS

A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completions of the installation.

B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

3.7 FIELD QUALITY CONTROL

A. Separate trenches for water lines, sanitary, storm, and gas piping.

B. Piping shall be labeled along entire length; indicating size, class, material specification, manufacturers name, and country of origin.

C. Piping and fittings resting on ground is unacceptable. Keep products covered. Provide temporary end caps and closures on piping and fittings.

D. Foreign pipe and fittings unacceptable.

E. Prior to cover up water pipe, sanitary pipe, and gas piping shall be pressure tested. Tests shall be witnessed by consultant and owner. Notify owner 48 hours prior to test. Test shall be witnessed by client plumbing technician.

F. The inside of all sanitary lines shall be video recorded with a camera and witnessed by owner to first outside manhole. Provide tape and/or DVD upon closeout of project. If any

obstructions are found they shall be removed and the line shall be videoed again to show the blockage has been cleared.

G. For additions and renovations, use camera to locate routing of underslab lines.

H. Upon completion of the sanitary piping system, the contractor shall notify engineer and owner to observe a smoke test of the system. Smoke testing shall be performed on sanitary piping system twice during construction.

I. At the time of the MEP punch list walk, plumbing contractor to demonstrate accessibility and proper removal of every clean-out plug with the use of a special tool. If a special tool IS required, three copies must be turned over to GPISD at close-out. Prior to substantial completion and after terrazzo, tile installation and painting has been completed, camera all sanitary and storm lines below slab.

END OF SECTION 22 13 16

SECTION 22 20 23 - GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

A. Provide a complete natural gas piping system to all gas-burning appliances and all natural connectors.

B. This section covers the complete first class natural gas system installation, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings, including but not limited to piping, regulators, unions, valves, installation, testing and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
   1. 2015 Edition of the International Fuel Gas Code.

   2. Latest Edition of NFPA 54, National Fuel Gas Code.

   3. Minimum Safety Standards for Natural Gas, 49 Code of Federal Regulations (CFR) Part 192, as Required by Title 16 of the Texas Administration Code § 8.70.

1.4 SUBMITTALS

A. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories.

   2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
   a. Strainers.
   b. Natural gas pressure regulators.
   c. Natural gas pressure relief valves.
   d. Tape form pipe coating.

B. Test Reports: Indicate results of piping system pressure test.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves, piping system, and system components.

B. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.6 QUALITY ASSURANCE

A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.

B. Valves: Manufacturer’s name, size, standards compliance and pressure rating clearly marked on outside of valve body.

C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years documented experience. Installation of natural gas systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. All installation shall be supervised by a licensed Master Plumber. All testing shall be performed by a licensed Journeyman or Master Plumber. Welders shall be certified in accordance with ASME Section 9.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.9 EXTRA MATERIALS

A. Furnish two packing kits for each type and size valve.

PART 2 - PRODUCTS

2.2 MANUFACTURERS

A. Products and materials listed herein are for references of approved materials.

B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.3 NATURAL GAS PIPING, BELOW GRADE

A. Steel Pipe: ASTM A53 Schedule 40 black.
   1. Fittings: ASTM A234/A234M forged steel welding type or ANSI LC-4/CSA 6.32 press-connect type (Viega MegaPressG, NIBCO BenchPressG).

   2. Joints: ASME B31.9, welded or ANSI LC-4/CSA 6.32, press-connect.

   3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

B. Contractor Option: Provide Underground Gas Polyethylene (PE), SDR-11, ASTM D2513 pipe and fittings with heat fusion socket joints.
   1. Polyethylene pipe and fitting materials shall be compatible and by same manufacturer to ensure uniform melting and a proper bond. Fabricated fittings shall not be used.

   2. Provide connection between buried plastic gas service piping and metallic riser in accordance with the gas code. Provide metallic riser consisting of HDPE fused coating on steel pipe for connection to above ground building distribution piping. Underground horizontal metallic portion of riser shall be at least twenty four inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser.

2.4 NATURAL GAS PIPING, ABOVE GRADE (OUTDOOR)

A. Piping 1½ inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.

B. Piping 2 inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.

C. Provide factory-applied, three-layer coating of epoxy, adhesive, and PE or field applied primer and epoxy paint coating on all pipe and fittings. Field applied coating is restricted to fittings and short sections of pipe necessarily stripped for threading or welding. Field

coating shall be manufactured by Amercoat Type 240 or approved equal and applied in accordance with manufacturer's recommendations. Galvanizing shall not be considered adequate protection.

D. All exposed piping interior and exterior shall be painted. Interior color shall be according to the adopted color codes and shall be appropriately labeled at interviews in specified height letters. Piping exposed to view shall be painted to comply to color scheme. Piping on roof or building exterior shall be painted with epoxy or polyurethane industrial coating.

E. Do not allow all-thread pipe nipples in any piping system.

2.5 NATURAL GAS PIPING, ABOVE GRADE (INDOOR)

A. Steel Pipe: ASTM A53 Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, ANSI LC-4/CSA 6.32 press-connect (Viega MegaPressG, NIBCO BenchPressG), or ASTM A234/A234M forged steel welding type.

   2. Joints: NFPA 54, press-connected through 2” max size or welded to ASME B31.9 above 2” size.

   3. EXCEPTIONS:
      a. All exposed piping 1½ inches and smaller located within areas utilized as return air plenums shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.
      b. All exposed piping 1½ inches and smaller serving laboratories from main natural gas riser to each emergency shut-off valve shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.
      c. Threaded joints at Gas regulator and equipment connections.

B. All exposed piping interior and exterior shall be painted. Interior color shall be according to the adopted color codes and shall be appropriately labeled at interviews in specified height letters. Piping exposed to view shall be painted to comply to color scheme. Piping on roof or building exterior shall be painted with epoxy or polyurethane industrial coating.

C. Do not allow all-thread pipe nipples in any piping system.

2.6 UNIONS AND COUPLINGS

A. Ferrous pipe: 150 psi malleable iron threaded connections.

B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 VALVES

A. Manufacturers:
   1. Apollo.
   2. NIBCO.
   3. Milwaukee.
   4. Watts.
   5. Homestead Valve.

B. Ball Valves:

1. 1/4 inch to 2-1/2 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70-UL.

2. 3 to 4 inch, MSS SP 110, 250 psi, two piece, threaded ends, brass body, stainless steel ball, reinforced teflon seats, blow-out proof stem, lever handle, UL listed for flammable liquids and LPG, Full port. Nibco T-FP-600A (CSA, UL, FM).

3. 3 inch and larger, MSS-SP-78, Type IV, Class 125, ASME/ANSI B16.38, 200 psi, lubricated plug valves with flanged or threaded ends. Bodies, plugs and bonnets shall be made from Gray Iron castings, ASTM A-126, Class B. Homestead Valve series 600 (CSA, UL, FM).

2.8 STRAINERS

A. Manufacturers:
   1. O.C. Keckley Company or approved equal.

B. Two (2) inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. 2-1/2 inch to four (4) inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.9 NATURAL GAS PRESSURE REGULATORS

A. Manufacturers:
   1. BelGas.
   2. Itron.
   3. Honeywell.
   4. Sensus.
   5. Maxitrol.
   6. Fisher.

B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
   1. Temperatures: minus 20 degrees Fahrenheit to 150 degrees Fahrenheit.

   2. Body: Steel.

   3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.

   4. Disk, diaphragm, and O-ring: Nitrile.

   5. Maximum inlet pressure: 150 psig

   6. Furnish sizes two (2) inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

2.10 NATURAL GAS PRESSURE RELIEF VALVES

A. Manufacturers:
   1. Fisher 289H, or approved equal.

B. Product Description: Spring loaded type relief valve.

1. Body: Aluminum.

2. Diaphragm: Nitrile.

3. Orifice: Brass.

4. Maximum operating temperature: 150 degrees Fahrenheit.

5. Inlet Connections: Threaded.

6. Outlet or Vent Connection: Same size as inlet connection.

2.11 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum six (6) inches wide by four (4) mil thick, manufactured for direct burial service.

2.12 PROTECTIVE COATING

A. Underground steel service entry piping shall be furnished with factory applied plastic coating and field coating at joints conforming to AWWA Standard C-203. All valves, fittings, and joints in underground piping shall be field coated using a heat-applied coal tar enamel tape, using two coats of heavy mastic, using “Scotchwrap,” “CT Tapecoat” or “X-Tru-Tape.” Field coating shall extend over mill wrapping a minimum of 4 inches. Damaged coating shall be repaired as specified for valves, fittings, and joints.

PART 3 - EXECUTION

3.2 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.3 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Install plastic ribbon tape continuous over top of pipe buried six (6) inches below finish grade, above pipe line.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

B. Establish minimum separation of gas pipe from other services, piping in accordance with code.

C. Install continuous jacket or tape.

D. Install gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

E. Install Work in accordance with Gas Company standards.

F. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.

G. Provide pipe sleeve as required for gas pipe routing under slab or in conceal space.

H. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

B. Provide rigid appliance connections for each gas-burning appliance in accordance with code.

C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

D. Provide an accessible, approved shut-off valve within three (3) feet of each gas appliance. Install such that appliance can be maintained and removed without removal of the shutoff valve.

E. Install gas pressure regulator vent full size opening on regulator and terminate outdoors.

F. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

G. Install service pipe and set gas meters in accordance with Gas Company regulations. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.

H. Gas piping installed in plenums and chases shall be welded.

I. Provide shut-off valves on both sides of all gas regulators for isolation of gas regulators.

J. Install a test port of each side of all natural gas pressure regulators.

K. Perform a pressure test of all replaced natural gas piping.

L. Gas piping on roof shall be supported at appropriate intervals to prevent sagging. Spacing shall be determined by the roof type and loading. No piping shall rest directly on the roof.

M. All supports shall be manufactured for the purpose of supporting pipe. Wood blocks are not an acceptable means of pipe support.

3.6 FIELD QUALITY CONTROL

A. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.

B. Defective joints or piping shall be replaced as required and the system shall then be re-tested.

END OF SECTION 22 20 23

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

A. Provide complete installation for each equipment type listed in this section.

B. Section Includes:
1. COMMERCIAL NATURAL GAS DOMESTIC WATER HEATER
2. VACUUM RELIEF VALVES
3. IN-LINE CIRCULATORS
4. T & P RELIEF VALVES
5. DIAPHRAGM-TYPE EXPANSION TANKS
6. GARBAGE DISPOSAL
7. SCALE PREVENTION FLUID DYNAMICS
8. ELEVATOR SUMP PUMP (ESP-1) - Standard
9. LINT INTERCEPTOR – LT-1
10. BACKFLOW PREVENTERS
11. WATER PRESSURE REGULATING VALVES
12. WATER HAMMER ARRESTORS
13. THERMOSTATIC MIXING VALVES
14. SOLENOID VALVES
15. INLINE WATER SERVICE FILTER
16. FLOW METER
17. TEMPERATURE INSTRUMENTS

1.3 SUBMITTALS

A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.

B. Manufacturer's Installation Instructions: Submit mounting and support requirements.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept all equipment on site in original labeled cartons. Inspect for damage.

B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 EXTRA MATERIALS

A. Furnish two pump seals.

PART 2 - PRODUCTS

2.1 COMMERCIAL NATURAL GAS DOMESTIC WATER HEATER (Min 95% EFF)

A. Manufacturers:
1. AO Smith,
2. Bradford White,
3. American water heater,
4. Rheem
5. State

B. Furnish and install condensing, low NOx, modulating natural gas-fired domestic water heaters with a minimum thermal efficiency of 95% when tested to ANSI Z21.10.3 with the standby loss, and all other requirements of latest edition of ASHRAE 90.1b. The unit shall be NSF 61 standard tested and compliant for drinking water use. The dimensions, capacities, natural gas requirements and electrical characteristics of the water heater shall be as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements scheduled on Contract Drawings, indicated herein and fit properly in the space provided.

C. Gas water heater(s) shall be equipped with a powered gas burner with electronic flame safeguard, intermittent electronic ignition, main and pilot automatic gas valves, redundant solenoid gas valve, gas pressure regulator, diaphragm switch for proof of boiler operation, and flame inspection port. Maximum gas supple pressure to heater(s) shall be 13” W.C., and ASME working pressure shall be 160 psi. Water heater(s) shall have the followings:
1. Modulating gas burner that automatically adjusts the input based on demand.
2. Powered anodes that are non-sacrificial and maintenance free.
3. Have seamless glass-lined steel tank construction, with glass lining applied to all water-side surfaces after the tank has been assembled and welded.
4. Have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up
5. Be approved for 0˝ clearance to combustibles.

D. The control shall be an integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout and other components shall include manual-reset high-temperature limit control, upper and lower thermostats, combination temperature and pressure gauge,

low-water cutoff, ASME-rated temperature and pressure relief valve, drain valve and draft regulator. Control compartment door shall be hinged for easy access.

1. All models are design certified by Underwriters Laboratories (UL), Inc., according to ANSI Z21.10.3 standards governing storage type water heaters.
2. Meet the thermal efficiency and standby loss requirements of the U. S. Department of Energy and current edition ASHRAE/IES 90.1. Complies with SCAQMD Rule 1146.2 and other air quality management districts with similar requirements for low NOx emissions.

E. The heater(s) shall meet or exceed current standard or ASHRAE/IESNA 90.1 for recovery efficiency and standby loss. The tank shall have a 10-year warranty against failure as outlined in the written warranty. Professional start-up service shall be included.

F. The tank shall be glass lined with alkaline borosilicate composition and fused to the steel by firing at 1600°F and shall be insulated with fiberglass insulation. The heater will also be equipped with multiple anodes for cathodic protection. Heater(s) shall be equipped with 1-1/2” NPT water inlet and outlet openings, and two 3” handhole cleanouts. The heater(s) shall be constructed on accordance with ASME code, and the entire unit listed by Underwriters Laboratories.

G. Water heater(s) shall capable for remote monitoring, leak detection and fault alert. Provide dry contacts for shut down command from CO monitor.

H. Capacities: GHW-X (X = as scheduled); Water storage as scheduled; Located in hot water boiler room, gallon per hour recovery at 100-degree rise.

1. Accessories:
   a. Provide regulator for 5 lb. gas service pressure.
   b. Provide single point power connection as scheduled.
   c. Provide neutralization drain kit as required.
   d. Provide Concentric vent kit as required.
   e. Provide integral heat traps.
   f. Provide drain pan.

2. 120K-250K BTU Input: For Standard Power Venting: Water heater(s) shall be suitable for power venting using a 4” diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping. For Power Direct Venting: Water heater(s) shall be suitable for power direct venting using a 4″-diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping and (120 ft.) equivalent feet of intake air piping.
3. 300K - 500K BTU Input: For Standard Power Venting: Water heater(s) shall be suitable for standard power venting using a (6″) diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping. For Power Direct Venting: Water heater(s) shall be suitable for power direct venting using a (6″) diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping and (120 ft.) equivalent feet of intake air piping.

2.2 VACUUM RELIEF VALVES

A. Construction shall be bronze body with silicone disc having a dry guide which is located out of the water. Unit shall open at less than 1/2" vacuum and be suitable for use within a system having a maximum water pressure of 200 psi and a maximum temperature of 250°F. Vacuum relief valves shall be in compliance with the appropriate requirements of ANSI Z21.22.

B. Vacuum relief valves shall be manufactured by Watts Regulator, Wilkins or Conbraco.

2.3 IN-LINE CIRCULATORS

A. Manufacturers:
1. Bell and Gossett
2. Taco
3. Aurora
4. Armstrong
5. Grundfos

B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 80 psig, 150 psig maximum working pressure.

C. Casing: Cast iron, with flanged pump connections.

D. Impeller: Cast bronze, dynamically balanced and keyed on shaft.

E. Bearings: Two, oil lubricated bronze sleeve, integral thrust collar.

F. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.

G. Drive: Flexible coupling.

H. CP-1, 1/6 HP or as scheduled and fitted with remote heat sensing aqua-stat and timer.

I. Aqua-stat: Honeywell – Model L4006A1009 (100 – 240 degree range) or approved equal by Johnson Controls and Dayton.

J. Timer: Armstrong – Model 810233-130 or approved equal by Taco, Bell and Gossett, Grundfos, or Armstrong

2.4 T & P RELIEF VALVES

A. Manufacturers: Watts Industries or approved equal.

B. Temperature and Pressure Relief:
1. ANSI Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees Fahrenheit, capacity ASME Section IV certified and labeled.

C. Vacuum Relief Valves:
1. Watts N36 Lead Free Series.

2.5 DIAPHRAGM-TYPE EXPANSION TANKS

A. Manufacturers: Bell & Gosset PT Series or approved equal.

B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.

D. Provide separate support to structure for expansion tank

2.6 GARBAGE DISPOSAL

A. Insinkerator Model 444, 120V, 3/4 HP, provide all trim and accessories for City approved installation.

2.7 SCALE PREVENTION FLUID DYNAMICS

A. Provide an industry proven catalytic solution for scale prevention method by using a chemical free connector between equipment and point of use.

B. Consists of a non-sacrificial lead-free catalytic core made from a special alloy housed within a non-reactive stainless steel (304) tube Approved manufacturers.
1. Natural Sof.
2. Fluid Dynamics.

C. Provide connection to the followings.
1. Hot water heater serving the kitchen area.
2. Dishwasher.
3. Ice Maker.
4. Cooking Equipment.

D. Coordinate with food service supplier for equipment hookup.

2.8 ELEVATOR SUMP PUMP (ESP-1)

A. General: Submersible type, Pump motor shall be hermetically sealed, submersible type operating in a high-quality dielectric oil for cooling the windings and for lubrication of the motor bearings and ceramic-carbon shaft seal. Single-phase motor shall have internal automatic resetting, thermal overload protection.

B. Pump: Construction shall be of cast iron with 100% baked-on powder-coated epoxy finish for corrosion resistance and longer casting durability. All fasteners and external metal parts shall be of stainless steel.

C. Motor: Constructed to operate continuously without overheating while submerged, built-in automatic reset thermal protection, cord length as required.

D. High Water Alarm: Provide a high-water alarm assembly consisting of a NEMA rated enclosure, Auxiliary dry contacts, and UL/CSA listed.

E. Characteristics: Sump Pump

GPM	50
Head in Feet	20
Minimum Horsepower	1/2
Maximum RPM	1750
Voltage / Phase	Ref: Electrical
Manufacturer	Zoeller

F. Manufacturer: Zoeller as indicated or comparable model by Gould, Stancor, Aurora, Pacific, Hydromatic Paco.

2.9 LINT INTERCEPTOR (LT-1)

A. Manufacturers:
   1. Striem TT Series.

B. Trough Capacity: TT-8, 55 gallon capacity or as shown on Plumbing plans and details.

C. Construction:
   1. Striem Tuff Trough shall be lifetime guaranteed and made in the USA of 3/4" polyethylene. Trough shall have removable, corrosion-resistant primary filter screen and secondary filter basket. Trough shall be furnished with a nested cover, internally sloped floor, and suitable for above- or below-grade installation. Trough shall be equipped with a plain end outlet. Inlet connections are field installed. Cover shall have a maximum 450 lbs. load capacity. Maximum operating temperature 165°F intermittent.
   2. Provide above grade installation. Coordinate requirements with Structural drawings and details prior to rough-in.

2.10 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers
   1. Comply with ASSE 1013.
   2. Bronze body, with bronze internal parts and stainless-steel springs.
   3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
   4. Manufacturers:
      a. Febco 825Y.
      b. Hersey FRP II
      c. Wilkins 975.
      d. Watts Series LF909, or approved equal

B. Double Check Valve Assemblies:
   1. Comply with ASSE 1012.
   2. Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.
   3. Dual Check Valve with Atmospheric Vent shall be installed at referenced cross-connections. Valve shall feature stainless steel and rubber internals protected by an integral strainer. Primary check shall be rubber to rubber seated, backed by the secondary check with rubber to metal seating.
   4. Manufacturers:
      a. Febco 815.
      b. Hersey BCP
      c. Wilkins 760.
      d. Watts Series 9D or approved equal.

C. Dual Check Valves:
   1. Comply with ANSI/NSF Standard 18, Manual Food and Beverage Dispensing Equipment. (ASSE 1022 Approved Dual Check Valve).
   2. Body and adapters are of 316 stainless steel construction and all rubber components comply with FDA food additive regulations.
   3. All materials in contact with the potable water are in compliance with the requirements of the Safe Drinking Water Act, Public Law 93-523, National Interim Primary Drinking Water Regulations.
   4. Manufacturers:

a. Wilkins 740.
b. Watts Model SD-2/9BD, or approved equal

D. Lead Free

2.11 WATER PRESSURE REGULATING VALVES

A. Low to Moderate Flow Systems (Less Than 70 GPM) and Individual Equipment
1. Sizes 1/2" through 2"
2. All bronze body
3. 0.25% maximum weighted average lead content
4. Integral stainless-steel strainer screen
5. Built-in bypass check valve
6. FDA approved elastomers
7. Renewable seat
8. Union end connection
9. Rated for water temperature up to 180°F and minimum 300 psi inlet pressure. Provide model with inlet pressure rating, reduced pressure range and factory preset outlet pressure as scheduled on Contract Drawings.
10. Manufactured by Wilkins Series 600XL or approved equal by Watts

B. Large Demand Systems
1. Sizes 1-1/4” through 2 - ASTM B62 bronze body
2. Sizes 2-1/2” and larger - ASTM A536 ductile iron body
3. Pressure reducing pilot control
4. Stainless steel disc guide, seat and bearing cover
5. Stainless steel stem, nut and spring
6. FDA approved Nylon reinforced Buna-N rubber diaphragm
7. Provide model(s) with size, temperature range, inlet pressure rating, reduced pressure range, outlet pressure and options as scheduled on Contract Drawings.
8. Cla-Val Company Series 90 or approved equal by Watts

2.12 WATER HAMMER ARRESTORS

A. Manufacturers: Watts Series LF15M2 Series or approved equal.

B. ANSI A112.26.1; copper construction, piston type sized in accordance with PDI WH-201.

C. Pre-charged suitable for operation in temperature range 33 to 180 degrees Fahrenheit and maximum 150 psi working pressure.

D. Access Panel: Acorn Model 8292 or approved equal.

E. Lead Free.

2.13 THERMOSTATIC MIXING VALVES:

A. Manufacturers:
1. Leonard.
2. Symmons
3. Lawler

B. Certified to ASSE Standard 1017, ASSE 1070, and meets the anti-scald requirements of ASSE Standard 1016.

C. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.

D. Capacity:
1. TMV-1: Flow capacity between 0.35 gpm Min. and 4 gpm Max. at 5 psi pressure drop. Lead Free.
   a. Model:
      (1) Lawler 1070 Series
      (2) Leonard – 170-LF
      (3) Symonns – 7-230-CK Series
2. TMV-2: 3 gpm Min. and 14 gpm Max. at 5 psi pressure drop. Lead Free
   a. Model:
      (1) Lawler 66-25
      (2) Leonard – LV-186-982-LF-STSTL-REC.
      (3) Symmons – 7-200
3. TMV-3: 3 gpm Min. and 30 gpm Max. at 5 psi pressure drop. Lead Free
   a. Model:
      (1) Lawler 66-80
      (2) Leonard – LV-186-983-LF-STSTL-REC.
      (3) Symmons – 7-400

E. Accessories:
1. Check valve on inlets.
2. Volume control shut-off valve on outlet.
3. Stem thermometer on outlet.
4. Strainer stop checks on inlets.

F. Cabinet: 16 gage stainless steel, for recessed mounting with keyed lock.

G. Mechanical Rooms: Omit cabinet, surface mount.

H. Mount:
1. TMV-1 in piping under lavatory/sink/etc.
2. TMV-2 in wall mounted stainless steel cabinet.
3. TMV-3 in wall mounted stainless steel cabinet

I. Lead Free.

2.14 SOLENOID VALVES

A. ASCO Series Next Generation

B. Provide at each kitchen cooking hood and at each science lab prep room and demo table where for automatic gas supply shut-off.

C. Coordinate electrical connections with Division 26.

2.15 INLINE AUTOMATIC WATER FILTER

A. A 10 to 25 micron Water filter to be provided on the main cold-water line (Amiad SAF series).

B. The SAF series are automatic filters, with a self-cleaning mechanism driven by an electric motor. The SAF filters are designed to work with various types of screens in filtration

degrees from 800 to 10 micron. The ABF series is available in inlet/outlet diameters of full size as incoming water service.

C. Controller shall be Electro-Mechanical Relay and Timer. The self-cleaning cycle begins under any one of the following conditions:
   1. Receiving a signal from the Pressure Differential Switch.
   2. Time interval parameter set at the control board.
   3. Manual Start.

D. Power.
   1. 460/3/60
   2. Coordinate electrical connections with Division 26.

2.16 FLOW METER

A. Water meter
   1. Provide clamp-on ultrasonic water flow meter at the main water point of entry or as indicated on plan.
   2. Provide Onicon F-4300 meter with the followings.
      a. Accuracy +/- 1.0% of reading from 1.6 ft/s to 20 ft/s
      b. Repeatability +/- 0.25 % of reading
      c. Bi-directional flow range of 1.6 to 40 ft/s
      d. Process pipe-wall temperature: 32°F to140°F
      e. Power supply: 120VAC , 60 Hz, 10 VA max. .(provide transformer as needed)
      f. Output signals:
         (1) 4-20 mA DC current output
         (2) Pulse (configurable)
         (3) Relay (configurable)
      g. Digital communications: RS-232, RS-485, Modbus RTU
      h. Materials:
         (1) Enclosure NEMA 4X
         (2) Transducers IP68 (Encapsulated)
      i. Standard cable length: 25 ft (9 m), Maximum cable length: 100 ft (30 m)
   3. Acceptable Manufacturers:
      a. Sierra
      b. Siemens
      c. Dynasonics
      d. Onicon

B. Natural/Propane gas meter
   1. Provide insert mass flow meter at the main water point of entry or as indicated on plan.
   2. Provide Onicon F-5500 meter with the followings.
      a. Accuracy +/- 0.5% of reading from 0.16 ft/s to 20 ft/s
      b. Repeatability +/- 0.25 % of reading
      c. Bi-directional flow range of 0.16 to 40 ft/s
      d. Process pipe-wall temperature: 32°F to140°F
      e. Input power: 12-28 VDC, 6 W min.
      f. Power supply: 120VAC , 60 Hz, 10 VA max.(provide transformer as needed)
      g. Output signals:
         (1) 4-20 mA DC current output
         (2) Pulse (configurable)
         (3) Relay (configurable)

h. Digital communications: RS-232, RS-485, Modbus RTU
i. Materials:
(1) Enclosure NEMA 4X
(2) Transducers IP68 (Encapsulated)
j. Standard cable length: 15 ft (9 m), Maximum cable length: 100 ft (30 m)

3. Acceptable Manufacturers:
a. Sierra
b. Thermal Instrument Co.
c. Dynasonics
d. Onicon

C. Blowdown meter
1. Provide 2” stainless steel water flow meter with pulse output at the cooling tower blow down line or as indicated on plan.
2. Provide PRM # WM200SSVX meter with the followings.
a. Accuracy +/- 5.0% of transitional flow and +/- 2.0% normal flow
b. Process pipe-wall temperature: 32°F to104°F
c. Flow range: 2-100 GPM.
d. Output signals:
(1) Pulse (configurable)
e. Materials:
(1) 304 Stainless steel
(2) Seal: Viton
f. Standard cable length: 10 ft (9 m), Maximum cable length
3. Acceptable Manufacturers:
a. Stenner
b. EKM
c. Carlon Meter
d. PRM

D. Warranty
1. Products are warranted to be free from defects in material and workmanship and will be repaired or replaced at no charge to the owner, provided return or rejection of product is made within a reasonable period but no longer than one (1) year for calibration and non-calibration defects, from date of delivery

2.17 TEMPERATURE INSTRUMENTS

A. Manufacturer: Trerice, Taylor, Marsh, Weksler, Marshalltown, Weiss, or Miljoco.

B. Thermometer Wells.
1. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
2. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
3. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
4. Wells shall be sized to extend a minimum of 50% into pipe

2.18 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Coordinate required voltage, wire size and over current device size with electrical drawings. Contractor shall provide all electrical connections per manufacturer's installation instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment on concrete housekeeping pad, minimum 4 inches high and six (6) inches larger than water heater base on each side. Refer to Section 03 30 00

B. Install water heater with the followings.

1. Maintain manufacturer's recommended clearances around and over water heaters.

2. Connect natural gas piping in accordance with NFPA 54.

3. Provide water heater pan beneath all water heaters with 3/4-inch drain to nearest floor sink.

4. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.

5. Install the following piping accessories.

a. On supply:

(1) Thermometer well and thermometer.

(2) Strainer.

(3) Pressure gage.

(4) Shutoff valve.

(5) Diaphragm-type expansion tank

b. On return:

(1) Thermometer well and thermometer.

(2) Pressure gage.

(3) Shutoff valve.

6. Install the following piping accessories on natural gas piping connections.

a. Strainer.

b. Pressure gage.

c. Shutoff valve.

d. Pressure reducing valve.

7. Install discharge piping from relief valves and drain valves to nearest floor drain.

8. Install circulator and diaphragm expansion tank on water heater.

9. Install water heater trim and accessories furnished loose for field mounting.

10. Install electrical devices furnished loose for field mounting.

11. Install control wiring between water heater control panel and field mounted control devices.

12. On gas-fired equipment connect flue to water heater outlet, full size of outlet.

13. Provide factory start-up and demonstration, including operating instructions for all gas-fired water heaters. Schedule training sessions with Architect and Owner's representative. Provide certification letter from manufacturer indicating water heater is installed in accordance with manufacturer's instructions.

C. Circulating Pump Installation: Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

1. Install the following piping accessories.

a. On supply:

(1) Pressure gage.

(2) Shutoff valve.

(3) Check valve.

b. On return:

(1) Thermometer well and thermometer.

(2) Timer.

(3) Pressure gage.

(4) Shutoff valve.

D. Backflow Preventers and Vacuum Breakers.

1. Isolate all non-potable water requirements from the building domestic water system with backflow prevention device manufactured and certified for the particular application.

2. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.

3. Backflow preventers shall be duplexed full-size where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.

4. Test ports shall not be located more than 72 inches above finished floor or permanent platform.

5. Do not install vacuum breakers or backflow preventers above equipment, above ceilings, concealed within walls, or areas where water leakage can cause damage.

6. Install a strainer immediately upstream of each vacuum breaker and backflow preventer.

E. Water Hammer Arrestors (Hydraulic Shock Absorbers).

1. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch, battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving equipment.

2. Locate and size hydraulic shock absorbers in accordance with PDI-WH-201 Standard and manufacturer's published recommendations.

3. Install hydraulic shock absorbers with clearances to allow inspection, removal and replacement. Provide access panels where required.

F. Water Pressure Regulating Valves.

1. Provide isolation valve, strainer and pressure gauge immediately upstream of each pressure regulating valve.

2. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.

3. Installation shall allow sufficient access to and space around components for adjustments and servicing.

4. Provide services of a direct factory representative for start-up service, inspection and necessary adjustments for all large demand regulators

G. Install diaphragm-type expansion tank on cold water supply line.

H. Install flow meter on cold water supply line and gas line at point of entry. Coordinate with div. 23 (BAS) for signal output and div. 26 for power requirements.

I. Sewer and Sump pump Discharge Piping:

1. Factory or field fabricated, galvanized, ASTM A53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class125, cast-iron flange and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings.

2. Underground piping shall be Copper Tubing: ASTM B88, Type K. Fittings: ASME B16.22 wrought copper and bronze. Joints: AWS A5.8, BCuP silver braze.

END OF SECTION 22 30 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

A. Provide a complete system of plumbing fixtures and trim.

B. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.3 SUBMITTALS

A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.5 EXTRA MATERIALS

A. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.

PART 2 - PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

A. Fixture Manufacturers:
   1. American Standard.

   2. Eljer

3. Crane

4. Toto

B. Fixture Trim Manufacturers:
1. Sloan Royal

2. Zurn Aquaflush XL

3. Toto

C. WC-1: ASME A112.19.2M; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2 inch top back spud, china bolt caps. Provide as indicated on plumbing fixture schedule.
1. Wall Mounted: American Standard 3351.101.020
2. Or as indicated on schedules.
3. Trim : (Type C)

D. WC-2: Same as WC-1, except mounted at ADA/TAS height for appropriate age group.
1. Wall Mounted: American Standard 3351.101.020
2. Or as indicated on schedules.
3. Trim : (Type C)
4. Provide flush valve stem offset as required.

E. Trim:
1. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2” offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Sloan Model Royal or Zurn AV Series or Sloan 111-1.28 (standard), Sloan 115-1.28 DFB (ADA) or provide as indicated on plumbing fixture schedule

F. Seat: White plastic, open front, extended back, self-sustaining hinge, stainless steel mounting hardware, brass bolts, with without cover. Manufacturer: Bemis, Beneke, Olsonite, Church, and Centoco. Bemis 1655SSCT or provide as indicated on plumbing fixture schedule.

G. Wall Mounted Carrier: ASME A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers. Jay R. Smith 200 series carriers, or equal by Zurn or Watts or Josam or Wade or Ancon.

2.2 WALL HUNG URINALS

A. Fixture Manufacturers:
1. American Standard

2. Eljer

3. Crane

4. Toto

B. Fixture Trim Manufacturers:
   1. Sloan Royal
   2. Zurn Aquaflush XL
   3. Toto

C. All urinal flush valves shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

D. U-1: ASME A112.19.2M; vitreous china, wall hung, elongated rim integral trap, removable stainless steel strainer, 3/4 inch top spud, provide chair carrier as required. American Standard Pintbrook Model 6002.001 or provide as indicated on plumbing fixture schedule.
   1. Trim : (Type C)

E. U-2: Same as U-1, except mounted at ADA/TAS height for appropriate age group.
   1. Trim : (Type C)

F. Trim:
   1. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, integral screwdriver stop with vandal resistant stop cap, vacuum breaker; maximum one (1) pint flush volume. Sloan Model Royal, or Zurn AV series. Sloan Flushometer 186-0.125 DBP or provide as indicated on plumbing fixture schedule.

G. Wall Mounted Carrier: ASME A112.6.1; cast iron and steel frame with rectangular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. Provide bottom bearing plate. Jay R. Smith figure 0637, or equal by Zurn and Watts or Ancon or Wade or Josam or provide as indicated on plumbing fixture schedule.

2.3 LAVATORIES

A. Fixture Manufacturers:
   1. American Standard Plumbing.
   2. Eljer
   3. Crane
   4. Toto

B. Fixture Trim Manufacturers:
   1. T & S Brass.
   2. Chicago.

C. Supply Fittings Manufacturers:
   1. Chicago.
   2. McGuire.

3. Brasscraft.

4. Zurn.

D. All lavatory faucets and trim shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

L-1, Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0355.012 vitreous china wall hung lavatory 21 x 18 inch minimum, with four (4) inch high back, 3 deck holes, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type. Provide as indicated on plumbing fixture schedule.

1. Trim : (Type F2) Student Restrooms
2. Trim : (Type F3) Faculty / Staff Restrooms

E. L-2, Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0356.421 vitreous china wall hung lavatory 21 x 18 inch minimum, with four (4) inch high back, single deck hole, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type. Provide as indicated on plumbing fixture schedule.

1. Trim : (Type F2) Student Restrooms
2. Trim : (Type F3) Faculty / Staff Restrooms

F. Trims:

1. Supply Fitting: ASME A112.18.1 (Type F2); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucets Model 857-E12- 665PSHCP or provide as indicated on plumbing fixture schedule.
2. Supply Fitting: ASME A112.18.1 (Type F3); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucets Model 797A or provide as indicated on plumbing fixture schedule

G. Accessories:

1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.

2. Chrome plated 17 gage open grid P. O. plug.

3. Removable key stops.

4. Flexible supplies.

5. Trap and waste insulated and offset to meet ADA compliance.

6. Tempering valve – Power LFe480 series, Acorn, or Leonard.

7. Lavatory faucet supplies: 3/8” Chrome plated copper attached to a ½” IPS x 3/8” compression chrome plated loose-key stop. All exposed chrome plated fittings polished.

H. Floor Mounted Carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, concealed arm supports, bearing plate and studs. Jay R. Smith 710 Series, or equal by Zurn and watts.

2.4 SINKS

A. Fixture Manufacturers:
1. American Standard
2. Eljer
3. Crane
4. Toto

B. Fixture Trim Manufacturers:
1. Chicago Faucet Co.
2. T & S Brass
3. Symmons
4. Speakman

C. Supply Fittings Manufacturers:
1. Chicago.
2. McGuire.
3. Brasscraft.
4. Zurn.

D. All sink faucets and trim shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

E. SK-1: Single Compartment Bowl: ASME A112.19.3; 19-1/2 x 19-1/2” x 6-1/2 inch outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ191965PD or provide as indicated on plumbing fixture schedule.

1. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4” vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8” fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-G8AE26-F-317AB, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.

F. SK-2: Double Compartment Bowl: ASME A112.19.3; 33 x 19-1/2 x 6-1/2 inch outside dimensions 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drains 3-1/2 inch crumb cups and tailpieces, ledge back drilled for trim. Elkay Model LRADQ331965PD or provide as indicated on plumbing fixture schedule.
1. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4” vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8” fixed Center, dual supply for hot and cold water service

Chicago Faucets Model 201-AGN8AE26-F-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.

G. SK-3: Single Compartment Bowl: ASME A112.19.3; 25" x 21-1/4" x 6-1/2" outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ252165PD or provide as indicated on plumbing fixture schedule.

1. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE26-F-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.

H. SK-4: Single Compartment Bowl: ASME A112.19.3; 16-3/4" x 15-1/2" x 6" outside dimensions, 20 gauge, Type 304 stainless steel with a buffed satin finish, center drain. Elkay Model CHS1716C or provide as indicated on plumbing fixture schedule.

1. Trim: (Type L1) ASME A112.18.1; 8" centerset wall mount faucet with 4" Gooseneck Spout 2" Lever handles 1/2" offset inlets. Vandal resistant aerator standard with 1.5 gpm, chromo plate brass with quarter turn ceramic disc valve and requires 2 faucet. Elkay Faucet Model LK940GN04L2H, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.

I. SK-5: Single Compartment Bowl floor mount: ASME A112.19.3; 39" x 27-1/2" x 14" outside dimensions, 14 gauge, Type 304 stainless steel with a buffed satin finish, center drain. Elkay Model WNSF81362 or provide as indicated on plumbing fixture schedule.

1. Trim: (Type L1) ASME A112.18.1; 8" centerset wall mount faucet with 4" Gooseneck Spout 2" Lever handles 1/2" offset inlets. 2.2 GPM vandal resistant aerator standard with 1.5 and .5 GPM insert included, chromo plate brass with quarter turn ceramic disc valve and requires 2 faucet. Elkay Faucet Model LK940GN04L2H, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.

J. Accessories:

1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.

2. Chrome plated 17 gage brass basket strainer.

3. Removable key stops.

4. Flexible supplies.

5. Trap and waste insulated and offset to meet ADA compliance.

K. Provide offset waste on all sinks.

2.5 EMERGENCY EYE AND FACE WASH (EW-1)

A. Manufacturers:

1. Guardian Safety Equipment

B. Performance: Unit complies with ADA requirements for accessibility by handicapped persons. Unit shall meet or exceed ANSI Z358.1 – 2004, and come with a full 2-year warranty.

C. ANSI Z358.1: Integrated in the casework, Guardian G1805 (or G1805LH as required by the project conditions) deck-mounted swivel rotating emergency eyewash. Flip top dust cover on plastic spray heads and soft-flow dual spray. Mounting on counter next to sink. ½" IPS plug-type valve with PTFE coated O-ring seals. Swinging head assembly from storage to operational position opens orifice and activates water flow. Unit remains in operation until head assembly is returned to storage position. Furnished with in-line strainer to protect valve and spray heads from debris in water line. Unit may be mounted on right side (G1805) or left side (G1805LH) of sink. Construction shall be polished chrome plated brass.
   1. Provide and install emergency eye and face wash at sinks where indicated, coordinate with architecture drawings and sink trim clearances.
      a. The mounting of the eyewash shall be coordinated such that it operates free and clear of any obstruction when swinging from storage position to the operational position, and the eyewash spray heads shall be above the sink basin in the operational position to reduce spillage.

D. Provide hot water supply connection, tempered with ANSI Z358.1-2014 and ASSE 1071 thermostatic mixing valve.

E. Furnish universal emergency sign.

2.6 SHOWERS (Regular) – (SH-1)

A. Manufacturers:

1. Speakman.

2. Leonard Valve Co.

3. Symmons

4. Powers

B. SH-1: ASME A112.18.1; concealed shower supply with pressure balanced or thermostatic mixing valves, integral service stops, chrome plated vandal-proof institutional head with integral wall mounting flange, built-in 1.5 gpm flow, and escutcheon. Acorn – SV16-LVR – 519 - MSH - F1.5 or provide as indicated on plumbing fixture schedule.

2.7 SHOWERS (ADA) – (SH-2)

A. Manufacturers:
1. Acorn Engineering Company.

2. Powers.

3. Approved equal.

B. SH-2 ADA: ASME A112.18.1 and ASSE 1016-2011; concealed shower supply with pressure balanced and thermostatic mixing valves, integral service stops, hand held shower () with 69 inch metal clad hose and 24 inch glide mounted on right hand side (),

flow rate 1.5 GPM. ACORN – SV16-LVR – HHC15 - HHSH - HHSE - IVB – SB – PK or provide as indicated on plumbing fixture schedule.

2.8 WHIRLPOOL VALVE

A. Manufacturers:
1. Leonard Valve Co.
2. Chicago Faucet Co.
3. Delta Faucet Co., Commercial Div.
4. Lasco Mfg.
5. Symmons

B. WP-1; ADA: ASME A112.18.1; exposed supply with pressure balanced thermostatic mixing valves, integral service stops, hand held shower with 9' inch metal clad hose. Leonard Model TM-356-26-W/HA, or provide as indicated on plumbing fixture schedule.

2.9 ELECTRIC DRINKING FOUNTAIN

A. Manufacturers:
1. Elkay Mfg.
2. Halsey Taylor

B. Supply Fittings Manufacturers:
1. Chicago.
2. McGuire.
3. Brasscraft.
4. Zurn.

C. All electric water coolers shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

D. Fountain: (EDF-3)
1. ARI 1010; (ADA) Hydroboost bottle filling station, bi-level cooler, wall mount, non-filtered 8 GPH Stainless. Mechanically activated, sanitary sensor activated, green counter, laminar flow, antimicrobial, real drain. Electronic bottle filler sensor with mechanical front and side bubbler pushbar. Halsey Taylor Model HTHB-HAC8BLSS-NF provide as indicated on plumbing fixture schedule.
2. Capacity: 7.6 gph of water with inlet at 80 degrees F and room temperature of 90 degrees Fahrenheit.
3. Electrical: 115V / 60HZ. Maximum 1/5 hp compressor, cord and plug for connection to electric wiring system including grounding connector.
4. Provide cane touch apron, Halsey Taylor Model 42522 for HAC Series or provide as indicated on plumbing fixture schedule.

2.10 SERVICE SINKS (SS-1)

A. Manufacturers:
   1. Fixture Manufacturers:
      a. Fiat Products
      b. Stern Williams
      c. Acorn
      d. Crane

   2. Fixture Trim Manufacturers:
      a. Chicago Faucet Co.
      b. Fiat Products
      c. Stern Williams
      d. T & S Brass & Bronze Works Inc.

B. SS-1: Single bowl 24 x 24 x 10 inch high. Receptor composed of pearl grey marble chips and white Portland cement ground smooth, grouted and sealed to resist stains, floor mounted, with 1-1/4 inch wide shoulders, vinyl bumper guard, stainless steel dome strainer. Stern Williams Model MTB-2424 or provide as indicated on plumbing fixture schedule.

C. Accessories:
   1. Sink Fittings: Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Stern Williams Model T-10-VB.

   2. Three (3) feet of 5/8 inch diameter plain end reinforced synthetic hose with stainless steel wall bracket. Stern Williams Model T-35.

   3. Mop hanger. Stern Williams Model T-40.

   4. Or provide as indicated on plumbing fixture schedule.

D. SS-2: 12” corner type w/drop front, bowl 32 x 32 x 12 inch high. Receptor composed of pearl grey marble chips and white Portland cement ground smooth, grouted and sealed to resist stains, floor mounted, with 1-1/4 inch wide shoulders, vinyl bumper guard, stainless steel dome strainer, floor mounted. Stern Williams Model SBC-1725 or provide as indicated on plumbing fixture schedule.

E. Accessories:
   1. Sink Fittings: Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Stern Williams Model T-10-VB.

   2. Three (3) feet of 5/8 inch diameter plain end reinforced synthetic hose with stainless steel wall bracket. Stern Williams Model T-35.

   3. Mop hanger. Stern Williams Model T-40.

   4. Or provide as indicated on plumbing fixture schedule

2.11 FLOOR DRAINS

A. Manufacturers:

1. Josam Mfg.,
2. Jay R. Smith Mfg.,
3. Zurn Industries
4. Mifab

B. Floor Drain (FD-1): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. Zurn ZN-415-BZ1 (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

C. Floor Drain (FD-2): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable light duty square nickel-bronze strainer with removable perforated sediment bucket. Zurn ZN-415N-P (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

D. Floor Drain (FD-3): ASME A112.21.1; Cast iron flanged receptor with seepage holes, acid resistant coated interior and indirect waste drain, nickel bronze rim and secured grate. Secondary strainer or sediment bucket with. Zurn ZN-1970-KC-11 (Vandal-Proof Secured Top) with 4” funnel drain for freezer drain only or provide as indicated on plumbing fixture schedule.

E. Hubdrain (HD-1): Zurn Z-551 Series (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

F. Hubdrain (HD-2): Stainless Steel. Zurn Z-1726 Series (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

2.12 FLOOR SINKS

A. Manufacturers:
1. Josam Mfg.
2. Jay R. Smith Mfg.
3. Wade Spec. Products
4. Zurn Industries
5. Mifab
6. Watts

B. Floor Sink (FS-1): Cast iron body with integral seepage pan, acid resistant interior, nickel bronze rim and secured 1/2 grate. Aluminum dome bottom strainer and eight (8) inch square top. Zurn ZN-1910-K Series (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

C.

D. FS-3: Zurn ZN-1900-KC, 12 inches, 1/2 grate (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

2.13 TRAP SEAL PRIMERS

A. Manufacturers:
1. PPP Inc.
2. Jay R. Smith Mfg.
3. Siouxchief
4. Zurn Industries
5. Mifab
6. Watts
7. Sloan

B. Trap Seal Primers-Pressure Drop Type (TP-1)
1. Adjustable to the static line pressure by use of the adjusting screw. System operating range is 20 psi minimum to 80 psi. The trap Primer is to be connected to a cold water supply with isolation valve.
   a. PPP Model P1-500 will prime 1-4 floor drains using DU-U Distribution unit.
   b. PPP Model P2-500 will prime 1-2 floor drains using DU-U Distribution unit.

C. Trap Seal Primers-Flush Valve Type (TP-2)
1. Vacuum breaker trap primer attached to water closet flush valve, similar to Sloan VBF-72-A.

D. Trap Seal Primer: (TP-3), Jay R. Smith 2699 Series.

E. Trap Seal Primers-electronic Type (TP-E)
   1. Vacuum breaker trap primer attached to water supply manifold, similar to Zurn Z-1020 with copper waterway.
   2. Accessories:
      a. Slow closing 24 VAC solenoid valve.
      b. 120 – 24 VAC transformers.
      c. Brass atmospheric vacuum breaker.
      d. Copper connection outlets

2.14 CLEANOUTS

A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers

B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast

iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure or approved equal.

C. Manufacturers:
1. Josam Mfg.
2. Jay R. Smith Mfg.
3. Wade Spec. Products
4. Zurn Industries
5. Mifab
6. Watts

D. Floor, Outdoors: Coated cast iron body with gasket seal ABS plug and round cast iron scoriated non-skid cover. Jay R. Smith, Model 4220-F-C-U.

E. Floor, Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round nickel bronze scoriated cover in service areas. Jay R. Smith, Model 4025 – F-C-U.

F. Wall Cleanout (WCO): Line type with lacquered cast iron body with bronze taper thread plug and round stainless steel access cover secured with vandal proof screw. Jay R. Smith Model 4420-U.

G. Floor, Stainless Steel Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round stainless steel scoriated cover in service areas. Jay R. Smith Model 9760 Series.

2.15 HOSE BIBS

A. Manufacturers:
1. Chicago
2. T&S

B. HB-1:
1. Manufacturers: Woodford Model B24 (Basis-of-Design only) or provide as indicated on plumbing fixture schedule.
2. Interior: Polish brass, anti-siphon, vacuum breaker, enclosed in flush mounted wall box and adjustable brass nut with deep stem guard.

C. HB-2:
1. Manufacturers: Woodford Model B65 (BOD only), or provide as indicated on plumbing fixture schedule.
2. Interior: Polish brass Bronze, automatic draining freezeless wall hydrant, single check hose connection anti-siphon vacuum breakers, hydrants drain as handle shut off , permanent type brass valve body with hemispherical seating surface.

D. HB-3:
1. Manufacturers: Woodford Model 24 (BOD only) or provide as indicated on plumbing fixture schedule.

2. Interior: Polish brass, anti-siphon, vacuum breaker and adjustable brass nut with deep stem guard.

2.16 WALL HYDRANTS

A. Manufacturers:
1. Josam Mfg.
2. Wade
3. Zurn Industries

B. Exterior Wall Hydrant (WH-1):
1. Woodford RB65 (Basis-of-Design only), Non-Freeze, or provide as indicated on plumbing fixture schedule.

2. ASSE 1019; Chrome, non-freeze, self-draining type with lockable recessed box hose thread spout, hand wheel locks shield and removable key, and integral vacuum breaker.

C. Roof Hydrant (RH-1):
1. Woodford SRH-MS (BOD only), ASSE 1057, or provide as indicated on plumbing fixture schedule.

2. The hydrant Features:
   a. The hydrant valve body is drilled and tapped with 1/8” drain hole which must be piped to a drain location.
   b. Rod guide eliminates side pull on rod, reduces wear on packing, packing nut & stem.
   c. Adjustable link for easy adjustment and positive lever lock tension.
   d. One piece variable flow plunger with large cushion type seal.
3. All necessary mounting hardware for proper installation on a commercial roof is supplied, including a 2 degree shim for pitch adjustment.
4. Contractor to route drain line to the nearest floor receptor as applicable. Pitch drain line uniformly toward drain outlet.

2.17 RECESSED VALVE BOX

A. Manufacturers: Guy Gray, or approved equal.

B. RVB-1, Refrigerator/Ice Machine: Stainless steel preformed rough-in box with brass valves with wheel handle slip in finishing cover. IPS Model SSMIB8AB.

a) Provide filter for every refrigerator.

C. RVB-2, Washing Machine: Galvanized steel preformed rough-in box with brass long shank valves with wheel handles, valves with single lever handle, socket for two (2) inch waste, slip in finishing cover. IPS Model SSWB-3.

2.18 DOWNSPOUT OVERFLOW

A. Nozzle Style:
1. Manufacturers: Jay R. Smith 1770 Series or provide as indicated on plumbing fixture schedule.
2. Product Description: Cast bronze body and wall flange round with offset bottom section.

B. Hinged Cover Style:
   1. Manufacturers: Jay R. Smith 1775-U Series or provide as indicated on plumbing fixture schedule.
   2. Product Description: Fabricated Type 304 Stainless Steel Downspout Cover with Hinged Perforated Cover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 31 13 - Administrative Requirements: Coordination and project conditions.

B. Verify walls and floor finishes are prepared and ready for installation of fixtures.

C. Verify electric power is available and of correct characteristics.

D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports wall carriers and bolts.

E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.

F. For ADA accessible water closets, install flush valve with handle to wide side of stall.

G. Water Heater: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

H. Janitor Closet: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

I. Commercial Washer: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

J. Provide power wiring, including control power transformers as required for all sensor type fixtures.

K. Bolt carriers to the floor.

L. All sinks shall have an offset rear centered drain.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. Hot water temperature outlet at each sink and lavatory shall be adjusted to 105 degree F maximum except for water supplying clothes washing machines and kitchen equipment which shall supply with 140 degree F.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not permit use of fixtures before final acceptance.

END OF SECTION 22 40 00

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

1.3 QUALITY ASSURANCE

A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.

B. All materials and distribution, and utilization equipment shall be UL Listed.

C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.

D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

1.4 COORDINATION WITH OTHER TRADES

A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.

B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.

C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.

D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished, and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.

E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical

Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

F. The mechanical trades shall coordinate with the electrical contractor to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

G. The design of the electrical systems is based on the mechanical equipment scheduled and shown on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical contractor shall be responsible for added cost and coordination with the electrical subcontractor. The mechanical contractor shall pay the electrical trades for the cost of the additional work and materials except for changes by addendum.

H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.

I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.5 DRAWINGS

A. The drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.

B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical, electrical, plumbing and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.6 SUBMITTALS

A. Provide shop drawings and complete product data as indicated in each specification section.

B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8-inch scale or larger, one drawing per building area. Provide 1/4-inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Obtain approval of coordination drawings prior to duct fabrication and mechanical system hanger rough-ins.

C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:

1. **Reviewed**: No further submittal action is required. Submittal to be included in O & M Manual.

2. **Revise and Resubmit**: Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.

3. **Rejected**: Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnished product named in Specification and or Drawings.

4. **Furnish as Corrected**: Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.

D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.

E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.7 SUBSTITUTIONS OF PRODUCTS

A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.

B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a

complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.

C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.

D. The Engineer and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.

E. Availability of specified items:

1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.

2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.

3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.

4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.

F. A request constitutes a representation that Offeror:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.

2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.

4. Waives claims for additional costs or time extension which may subsequently become apparent.

5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.

G. No substitutions will be considered after the Award of Contract.

1.8 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.9 INTERFERENCE DRAWINGS

A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8-inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.

B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Equipment listed below shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. Contractor shall adequately protect equipment such as but not limited to: Chillers, Air Handling Units, Fan coil Units, Roof top Units, Air Terminal Units, Boilers, Pumps, Air Devices, exhaust fans, variable frequency drives, ductwork, duct insulation, piping insulation, hydronic piping, air duct accessories, unit heaters, etc. from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging; original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

E. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.11 GENERAL ELECTRICAL REQUIREMENTS

A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.

B. Electrical materials and work provided shall be in accordance with Division 26.

C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.12 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.

B. Unless otherwise specified, the electrical supply being furnished is a 460-volt, 3 phase, 3 wire, 60 hertz source. No neutral connection is available from the 460-volt source. The manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220-volt, 120-volt, 24 volt, etc.).

C. Electric Motors:

1. For each piece of equipment requiring electric drive, provide a motor having started and running characteristics consistent with torque and speed requirements of the driven machine.

2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.

3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

4. Contractor shall verify electrical characteristics of each motor with electrical drawings.

5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.

6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.

7. Where possible, motors shall be factory mounted.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OWNER INSTRUCTION - GENERAL

A. Installing Contractor shall coordinate and provide on-site Owner training for all new equipment by factory trained specialists for all Mechanical and Plumbing equipment in two (2) separate training meetings. One (1) training session shall be prior to Owner's acceptance and occupancy, and the other training session shall occur (30) thirty days later. Sign-in sheets are required for both meetings and shall be included in close out submittals.

B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.

C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

D. Refer to individual equipment specifications for additional training requirements.

END OF SECTION 23 05 00

SECTION 23 05 14 - VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. The drive shall be designed specifically for variable torque applications. It is required that the drive manufacturer has an existing independent service organization.

B. The drive and all necessary controls as specified herein shall be supplied by the drive Manufacturer. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten (10) years.

C. For Air Handling Units with multiple fans (Fan Array) and motors, VFD manufacturer shall provide internal individual motor overloads to match quantity of fan motors. Refer to Air Handling Unit Schedule for fan motor quantity

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE)

    a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.

2. Underwriter’s laboratories

    a. UL508C

3. National Electrical Manufacturer’s Association (NEMA)

    a. ICS 7.0, AC Adjustable Speed Drives

4. IEC 16800 Parts 1 and 2

B. Testing:

1. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD. The VFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 104 degrees Fahrenheit at full rated load, on a motor. Drive input power shall be continuously cycled for maximum stress and thermal variation.

2. All testing and manufacturing procedures shall be ISO 9001 certified.

C. Failure Analysis:

1. VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and decap or delaminate of components and analyze failures within the component.

D. Qualifications:

a. VFD's and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable.

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Submit VFD's only after coordination with approved Air Handling Units, Pumps, and Cooling Tower Submittals (If applicable).

C. All Variable Frequency Drives serving various equipment such as but not limited to: Air handling Units, Pumps and Cooling towers shall be supplied by the same manufacturer.

D. Submittals shall include, as a minimum, the following information:

1. Outline Dimensions

2. Weight

3. Compliance to IEEE 519 - harmonic analysis for particular job site including total harmonic voltage distortion and total harmonic current distortion.

a. The VFD manufacture shall provide calculations specific to the installation, showing total harmonic voltage distortion is less than five (5) percent. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519 (latest version), guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior VFD installation.

b. If the voltage THD exceeds five (5) percent, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

1.5 WARRANTY

A. The warranty shall be (2) two years and shall begin from date of Certificate of Substantial Completion. The warranty shall include all parts, labor, travel time and expenses to provide on-site warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's original, unopened containers with identification labels intact.

B. The contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather,

moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.7 MANUFACTURERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. ABB – Basis of Design.
2. Danfoss.
3. Yaskawa.

PART 2 - PRODUCTS

2.1 ADJUSTABLE FREQUENCY DRIVES

A. The adjustable frequency drives (VFD's) shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure (NEMA 3R if outdoors or unconditioned space), completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), Integral Line Reactor(s), Capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output switching device. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.

1. Input 480 VAC +/- 10 percent, 3 phase, 48-63 Hz. The overvoltage trip level shall be 30 percent over the nominal, and the under-voltage trip level shall be 35 percent over the nominal voltage as a minimum.

2. Output Frequency 0 to 250 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.

3. Environmental operating conditions: 0 to 104 Degree Fahrenheit, 0 to 3300 feet above sea level, less than 95 percent humidity, non-condensing.

4. Conditioned indoors enclosure shall be rated NEMA 1 and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.

5. VFD's located in un-conditioned spaces or outdoors shall have rated NEMA 4X enclosure and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.

B. All VFD's shall have the following features:

1. All VFD's shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and

menus. The keypad shall be removable, capable of remote mounting, and shall have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD's.

2. The keypad shall include Hand-Off-Auto membrane selections. When in "Hand", the VFD will be started, and the speed will be controlled from the up/down arrows. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure and the VFD speed will be controlled via an external speed reference. The drive shall incorporate "bump less transfer" of speed reference when switching between "Auto" and "Hand" modes and vice-versa.

3. The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to ACS400-US-reprogram all parameters and customer interfaces for a particular application to reduce programming time.

4. The VFD shall have the ability to automatically restart after an over current, overvoltage, under voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

5. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.

6. The VFD shall be equipped with an automatic extended control power loss ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be one-cycle, based on full load and no inertia. Typical control power loss ride-through for a fan load shall be 2 seconds minimum.

7. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.

8. The customer terminal strip shall be isolated from the line and ground.

9. The drive shall employ current limit circuits to provide trip free operation:

    a. The Slow Current Regulation limit circuit shall be adjustable to 150 percent (minimum) of the VFD's normal duty current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.

    b. The Current Switch-off limit shall be fixed at 350 percent (minimum, instantaneous) of the VFD's normal duty current rating.

10. The overload rating of the drive shall be 110 percent of its normal duty current rating for one (1) minute in every ten (10) minutes. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-plole motors.

11. The VFD shall have an integral Line Reactor(s) to reduce the harmonics to the power line and to increase the fundamental power factor. The minimum impedance shall be three (3) percent.

12. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under load condition.

13. The VFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.

14. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection shall be provided in both drive and bypass modes.

15. The following operators shall be provided:

    a. Bypass Hand-Off-Auto

    b. Drive mode selector

    c. Bypass mode selector

    d. Bypass fault reset

16. The following indicating lights (LED type) shall be provided:

    a. Power-on

    b. External fault

    c. Drive mode selected

    d. Bypass mode selected

    e. Drive running

    f. Bypass running

    g. Drive fault

    h. Bypass fault

    i. Automatic transfer to bypass selected

17. Customer Interlock Terminal Strip: Provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes.

18. The following relay (form C) outputs from the bypass shall be provided.

    a. Drive run

b. Bypass run

c. Drive fault Bypass fault (motor overload or under load (broken belt)

19. Automatic or manual bypass (field selectable)

20. Manual or automatic bypass fault (field selectable)

21. Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure.

22. Door interlocked pad lockable circuit breaker which will disconnect all input power from the drive and all internally mounted options.

23. Fast acting semi-conductor fuses exclusive to the VFD - fast acting semi-conductor fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the Bypass will not be accepted.

24. Class 10 or 20 (selectable) electronic motor overload protection shall be included in the microprocessor bypass to protect the motor in bypass mode.

C. All VFD's to have the following adjustments:

1. Two (2) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

2. PID Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The auxiliary power supply shall have overload and over current protection. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.

3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference or for reference and actual (feedback) signals for PID controller. Analog inputs shall include a filter; programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0 - 20 ma and 0 - 10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz. Process variables shall be modifiable by math functions such as multiplication and division between the two signals (fan tracking), high/low select, as well as inverted follower.

4. Five (5) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (Enable). Upon remote, customer reset (reclosure of interlock) drive is to resume normal operation.

5. One (1) programmable analog output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

6. Two (2) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; Continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable. Relays shall be capable of programmable on and off delay times.

7. Seven (7) programmable preset speeds.

8. Two independently adjustable accel and decel ramps. These ramp times shall be adjustable from 1 to 1800 seconds.

9. The VFD shall Ramp or Coast to a stop, as selected by the user.

D. The following operating information displays shall be standard on the VFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

1. Output Frequency

2. Motor Speed (RPM, percent, or Engineering units)

3. Motor Current

4. Calculated Motor Torque

5. Calculated Motor Power (kW)

6. DC Bus Voltage

7. Output Voltage

8. Heat sink Temperature (0°F)

9. Analog Input Values

10. Analog Output Value

11. Keypad Reference Values

12. Elapsed Time Meter (resettable)

13. kWh meter (resettable)

14. mWh meter

15. Digital input status

16. Digital output status

E. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alphanumeric codes are not acceptable).

1. Over current trip 350 percent instantaneous (170 percent RMS) of the VFD's variable torque.

2. Current rating.

3. Overvoltage trip 130 percent of the VFD's rated voltage.

4. Under voltage trip 65 percent of the VFD's rated voltage.

5. Over temperature +90 degrees Celsius.

6. Ground Fault either running or at start.

7. Adaptable Electronic Motor Overload (I 2 t). The Electronic Motor Overload protection hall protects the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependant, are unacceptable. The electronic motor overload protection shall be UL approved for this function.

F. Speed Command Input shall be via:

1. Keypad.

2. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal.
3. Floating point input shall accept a three-wire input from a Dwyer Photohelic (or equivalent type) instrument.

4. Serial Communications

G. Serial Communications

1. The VFD shall have an RS-485 port as standard. The standard protocol shall be BACnet. Optional protocols that must be available are Johnson Controls N2 bus, Siemens Building Technologies FLN, LonWorks, Profibus and DeviceNet.

2. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, and accel/decel time adjustments. The drive shall allow the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), percent torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.

3. The VFD shall allow the DDC to control the drive’s digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive-in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

B. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with drive products offered shall be locally available at both the specifying and installation locations.

END OF SECTION 23 05 14

SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pressure gages.
2. Pressure gage taps.
3. Stem type thermometers.
4. Dial thermometer.
5. Thermometer supports.
6. Test plugs.
7. Bladder-type expansion tanks.
8. Air vents.
9. Combination Dir and Air Separators.
10. Strainers.
11. Flow controls / Balancing Valves.
12. Pump Suction Diffusers.
13. Relief valves.
14. Volume Tanks

B. Related Sections:

1. Section 23 21 23 - Hydronic Pumps: Execution requirements for piping connections to products specified by this section.

1.3 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: Submit for manufactured products and assemblies used in this Project.

1. Manufacturer’s data and list indicating use, operating range, total range, accuracy, and location for manufactured components.

2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.

3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.

4. Submit electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

D. Grooved joint couplings and fittings shall be shown on drawings and product submittals and be specifically identified with the applicable Victaulic style or series number.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and instrumentation.

B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.8 WARRANTY

A. Furnish one (1) year manufacturer warranty for piping specialties.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Weiss
2. Weksler
3. Dwyer

B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Stainless steel.
2. Bourdon Tube: Phosphor bronze.
3. Dial Size: 4-1/2 diameter.
4. Mid-Scale Accuracy: One (1) percent.
5. Scale: Psi.

2.2 PRESSURE GAGE TAPS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Weiss
2. Pete's Plug

B. Needle Valve: Brass, 1/4-inch NPT for minimum 300 psi.

C. Ball Valve: Brass 1/4-inch NPT for 250 psi.

D. Pulsation Damper: Pressure snubber, brass with 1/4-inch NPT connections.

E. Siphon: Brass, 1/4-inch NPT angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Trerice
2. Weiss

B. Thermometer: Rigid 90°F angle, blue colored, organic, mercury fill, Valox case, brass stem, ½ NPT brass thermowell, acrylic window, lens front, magnifying tube type, scale face of aluminum, white background with black graduations and markings

1. Scale Size: 5-1/2" long.
2. Molded Valox - V-shaped black case.
3. Window: Double Strength Glass
4. Stem: Brass, 1/2-inch NPT, and 2 inches long.
5. Accuracy: ±2% of full scale ASME B40.4 Grade A.
6. Calibration: Both degrees Fahrenheit and degrees Celsius.

2.4 DIAL THERMOMETERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Trerice
2. Weiss

B. Thermometer: 300 stainless steel, hermetically sealed, bimetallic, silicone dampened on ranges to 300°F coil, adjustable angle, ½ NPT, double strength glass window, balanced, black finish pointer, dial face of aluminum, white background with black and blue graduations and markings.

1. Dial Size: 5-inch diameter dial.
2. Window: Double strength glass.
3. Stem: 300 Stainless Steel, ¼" diameter NPT, 2-1/2" long.
4. Length of Capillary: Minimum five (5) feet.
5. Accuracy: ±1% of full scale ASME B40.4 Grade A.
6. Calibration: Both degrees Fahrenheit and degrees Celsius.

2.5 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.

B. Flange: Three (3) inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Pete's Plug

B. 1/4-inch NPT or 1/2-inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:

1. Neoprene core for temperatures up to 200 degrees F.

C. Provide extended stem to accommodate insulation.

D. Test Kit:

1. Carrying case, internally padded, and fitted containing:

a. One 2-1/2 inch 3-1/2-inch diameter pressure gages.
b. Two gage adapters with 1/8-inch probes.
c. Two 1-1/2-inch dial thermometers.

2.7 BLADDER-TYPE EXPANSION TANKS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Wheatly
2. Bell and Gossett
3. Wessels
4. Armstrong
5. Taco
6. Thrush

B. Tank: Welded steel, rated for maximum 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1. Size: As indicated on Drawings.

C. Bladder: Heavy duty butyl-FDA approved.

D. Gage Glass Set: Brass compression stops, guard, and 3/4-inch red line glass, maximum 24 inches length, long enough to cover tank for two (2) inches above bottom to two (2) inches below top.

E. Quick Connect Air Inlet:

1. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.

F. Automatic Cold-Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass valves.

G. Hot Water Heating System:

1. Select expansion tank pressure relief valve at 20 psi maximum.
2. Set pressure reduction valve at select 12 psi.

H. Chilled Water System:

1. Select expansion tank pressure relief valve at 25 psi maximum.
2. Set pressure reduction valve at 12 psi.

I. Do not insulate ASME stamp and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

2.8 AIR VENTS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Armstrong
2. ITT
3. Sarco

B. Manual Type: Short vertical sections of two (2) inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.

C. Float Type:

1. Brass, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

D. Washer Type:

1. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.

2.9 COMBINATION DIRT AND AIR SEPARATORS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Bell and Gossett
2. Armstrong
3. Wessels
4. Thrush

B. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.

C. Dirt & Air Separator: Each separator must be designed with a blow-down valve, skim valve, and automatic air vent. The separator must also utilize in its design a stainless-steel coalescing medium to aid in the separation of air and dirt in the system entrained water. The separator must be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure.

2.10 STRAINERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Bell and Gossett
2. Keckley
3. Armstrong
4. Mueller

B. Size two (2) inch and Smaller:

1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.

C. Size 2-1/2 inch to four (4) inch:

1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.

D. Size five (5) inch and Larger:

1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

2.11 STRAINERS (GROOVED) – APPLIES TO CHILLER ONLY

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Victaulic

B. Size four (4) inch and Larger:

1. Grooved iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

C. Couplings:

1. Grooved mechanical Installation ready couplings manufactured of a two segment, ASTM A 536, Grade 65-45-12 ductile iron cast housing. Gaskets shall be pressure responsive synthetic rubber, and pre-injected with lubricant, grade EHP or to suit intended service, conforming to ASTM D-2000. Gaskets shall rated for 250 degrees Fahrenheit and made by grooved manufacturer. Grooved couplings shall be provided “Installation-Ready”; pre-assembled and pushed onto grooved pipe end, joined by second grooved pipe end, and then bolts and nuts

are tightened down (no loose parts during installation). Coupling bolts shall be zinc plated heat-treated carbon steel track head conforming to ASTM A-183.

a. Sizes up to 12”: Rigid Type, Style 107; Flexible Type, Style 177.
b. Sizes 14” and larger: Rigid Type, Style W07; Flexible Type, Style W77.

2.12 FLOW CONTROLS / BALANCING VALVES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. TA / Victaulic

B. 2” and smaller: 300 psi threaded or sweat ends, non-ferrous Ametal® brass copper alloy body, EPDM o-ring seals. 4 turn digital readout hand wheel for balancing, hidden memory feature with locking tamper-proof setting. Victaulic / Tour and Anderson Series balancing valve 787 (threaded) or Series 786 (Sweat). Suitable for operating temperatures to 250°F.

C. 2-1/2” (DN65) and larger: 300 psi, grooved or flanged ends, ASTM A536 ductile iron body, all other metal parts of Ametal® brass copper alloy, EPDM O-ring seals. 8, 12 or 16 turn digital readout hand wheel for balancing, hidden memory feature with locking tamper-proof setting. Victaulic #788 (Flanged) or #789 (Grooved).

D. Calibration: Factory set to control flow within three (3) percent of design flow over entire operating pressure.

E. Accessories: In-line strainer on inlet and ball valve on outlet.

F. Victaulic coil hookup packages for ½”- 2” shall include a Victaulic/TA valve style 78k; 787 or 786 connection and the following two components: 78U, 78Y. The Victaulic balancing valve shall be sized to flow, and all components shall be from one manufacturer, Victaulic. Victaulic 78U Union Port Fitting: 1/2" through 2" by Sizes: 400 psi maximum, Sweat/Soldered or FPT threaded x Union ends, DZR forged brass body with manual air vent port and pressure/temperature port, with EPDM seals. Union port fitting shall provide a simplified terminal hookup for installation at coil outlets. Suitable for operating temperatures up to 250°F. Victaulic series 78Y Strainer Ball Valve combination ½” through 2” up to 400psi Ametal copper alloy body consisting of a full port ball valve and strainer with pressure and temperature measuring ports. Ball valve shall be complete with Teflon packing, plated ball, blow-out proof stem, and steel handle with vinyl grip. Strainer shall be Y-pattern, with 20 mesh stainless steel screen and blowdown port.

G. Victaulic coil hookup packages for 2½”- and larger shall include a Victaulic/TA valve style 788 or 789 and the following two components: 925 Air vent, 732 Y Strainer. The Victaulic balancing valve shall be sized to flow, and all components shall be from one manufacturer, Victaulic. Victaulic 925 Union Port Fitting: 2 1/2" through 4" by Sizes: 400 psi maximum CWP, Union port fitting shall provide a simplified terminal hookup for installation at coil outlets. Suitable for operating temperatures to 250°F. Victaulic series 732 Y Strainer 2 ½” through 4”. Strainer shall be Y-pattern, with 20 mesh stainless steel screen and blowdown port. Victaulic series 300 master seal butterfly valve for isolation on supply side.

H. All handles and pressure / sensor ports shall have extended stems to accommodate insulation.

1. Accessories: Test Kit.

2. Carrying case, internally padded, and fitted containing:

   a. One 2-1/2 inch 3-1/2-inch diameter pressure gages.
   b. Two gage adapters with 1/8-inch probes.
   c. Two 1-1/2-inch dial thermometers.

I. Coil Hook up Packages: Victaulic Series 799 including 78u air vent union fittings with extended probe sets with minimum 2” of clearance and 78y strainer/ball valves combination with extended handle and probe set with minimum 2” of clearance. Coordinate with manufacture to confirm insulation clearance. No flex hoses shall be used.

2.13 PUMP SUCTION DIFFUSERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   1. Victaulic

B. Angle pattern, with flanged outlet and grooved inlet connections.

C. 175-psig pressure rating, ductile-iron body and end cap, pump-inlet fitting.

D. 20 mesh stainless steel, type 304 fine mesh startup pre-filter and 5/32” perforated type 304 stainless-steel permanent strainers.

E. Stainless-steel straightening guide vanes.

F. Drain plug, blow-down tapping in bottom, gage tapping on side.

G. Factory-fabricated adjustable foot support.

H. Provide bosses on either side for pressure measurement.

I. Permanent magnet located in flow stream removable for cleaning.

2.14 RELIEF VALVES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   1. Bell and Gossett
   2. McDonnell-Miller
   3. Taco

B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

2.15 VOLUME TANKS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   1. Chemline
   2. Wendland

3. Wessels

B. Internal baffle to insure water mixing, ASME pressure rated to 125 psi at 400 degrees F, welded design, provide air vent and drain. Provide with tank supports for vertical installation. Gallon capacity as indicated on drawings. Select diameter as required to maintain an overall installed height less than or equal to the Architectural screen wall (where a screen wall is shown on Architectural drawings).

PART 3 - EXECUTION

3.1 INSTALLATION - THERMOMETERS AND GAGES

A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump, pipe to gage.

B. Install gage taps in piping with isolation valves.

C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.

E. Install thermometers in air duct systems on flanges.

F. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.

G. Locate duct-mounted thermometers minimum ten (10) feet downstream of mixing-dampers, coils, or other devices causing air turbulence.

H. Coil and conceal excess capillary on remote element instruments.

I. Install static pressure gages to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gage.

J. Provide instruments with scale ranges selected according to service with largest appropriate scale.

K. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

L. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES

A. Locate test plugs adjacent to pressure gages and pressure gage taps and as indicated on Drawings.

B. All Coil Kit valve assemblies shall come equipped with extended stems and extended handle to accommodate pipe insulation. Contractor shall coordinate pipe insulation thickness with coil kit manufacturer prior to ordering valves.

C. Install manual air vents at system high points.

D. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide drain and hose connection with valve on strainer blow down connection.

G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

H. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.

I. Support pump fittings with floor mounted pipe and flange supports.

J. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.

K. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Equipment relief valve capacity not to exceed rating of connected equipment.

L. Pipe relief valve outlet to nearest floor drain.

M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

N. Insulate all volume tanks to match adjacent intake and discharge piping and jacketing requirements.

O. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components. The gasket style and elastomeric material shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

1. Install piping products in accordance with the latest manufacturer’s installation instructions. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Use manufacturer grooving tools with roll sets to groove the pipe. Follow manufacturer guidelines for tool selection and operation. Products shall not be installed with standard grooved end pipe or components. Installing products in combination with standard grooved end products could result in joint separation and/or leakage.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Globe valves.
2. Ball valves.
3. Plug valves.
4. Butterfly valves.
5. Swing check valves.
6. Spring loaded check valves.
7. Flanges, unions, and couplings.
8. Vibration Isolation Suction and Discharge Pump Drops.

1.3 SUBMITTALS

A. Product Data: Submit Manufacturers catalog information with valve data and ratings for each service.

B. Welders Certificate: Include welder’s certification of compliance with ASME Section IX.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install valves underground when bedding is wet or frozen.

1.8 WARRANTY

A. Furnish one (1) year manufacturer warranty for valves.

1.9 EXTRA MATERIALS

A. Furnish two (2) packing kits for each size valve.

PART 2 - PRODUCTS

2.1 HEATING AND COOLING VALVES

A. Globe Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Nibco
   b. Crane
   c. Milwaukee Valve

2. Two (2) inches and Smaller: Construction: Bronze body, bronze trim, union bonnet, rising stem and hand-wheel, inside screw, renewable plug disc and stainless-steel seat ring, solder or threaded ends.

3. Two (2) inches and Larger: Construction: Iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

B. Ball Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Nibco
   b. Crane
   c. Belimo
   d. Milwaukee Valve
   e. Jomar Valve

2. Two (2) inches and Smaller: Bronze two-piece body, full port stainless steel ball and stem, Teflon seats and stuffing box ring, lever handle with balancing stops, solder, or threaded ends with union.

3. Two (2) inches and Larger: Cast steel body, stainless steel ball and stem, Teflon seat and stuffing box seals, lever handle, or gear drive hand-wheel for sizes ten (I0) inches and larger, flanged.

4. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive material. Also provide a protective sleeve to prevent damage to vapor seal when valve adjustment is made. Memory stops shall be adjustable after insulation is applied.

C. Plug Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Nibco
   b. Crane

2. Two (2) inches and Smaller: Bronze body, bronze tapered plug, full port opening, non-lubricated, Teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.

3. Two (2) inches and Larger: Cast iron body and plug, full port opening, pressure lubricated, Teflon packing, flanged ends. Furnish each plug valve with wrench with setscrew.

D. Butterfly Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Nibco
   b. Crane
   c. Dezurik
   d. Haleson
   e. Milwaukee Valve

2. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug ends, extended neck.

3. Disc: Aluminum bronze.

4. Operator: 10 position lever handle on sizes two and half (2 1/2) inches to four (4) inches.

5. Hand-wheel and gear drive on sizes larger than six (6) inches.

E. Butterfly Valves **-** Grooved: **Applies to HVAC pumps, air-cooled chillers and temporary chiller connections; refer to 2.2 of this spec section and Pump and Air-Cooled Chiller Detail.**

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Victaulic

2. Grooved end butterfly valves two (2) inches to twelve (12) inches shall have a ductile iron body, electroless nickel-plated ductile iron disc, blowout proof 416 stainless steel stem, disc shall be offset from stem centerline to provide full 360-degree seating, EPDM seat and seal material, TFE lined fiberglass bearings, lever handle or gear operator with memory stop feature equal to Victaulic Vic-300 MasterSeal.

3. Grooved end butterfly valves fourteen (14) inches to twenty-four (24) inches AGS grooved ends, polyphenylene sulfide (PPS) coated ductile iron body (ASTM A-536, Grade 65-45-12), PPS coated ductile iron disc (ASTM A-536), and two-piece 17-4 PH S/S stem design. Seat and seal material to suit intended service. Reinforced PTFE bearings and gear operator. Bubble tight, dead-end, or bi-

directional service. With memory stop for throttling, metering, or balancing service. Victaulic Vic®-300 AGS.

F. Spring Loaded Check Valves (Grooved): **Applies to Pumps and Air-Cooled Chillers; refer to 2.2 of this spec section and Pump and Air-Cooled Chiller Detail.**

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

a. Victaulic

2. Two and a half (2-1/2) inches to twelve (12) inches: Ductile iron body, aluminum bronze or elastomer encapsulated ductile iron disc, stainless steel spring and shaft, welded-in nickel or synthetic rubber seat with grooved ends equal to Victaulic Series 716.

3. Fourteen (14) inches to twenty-four (24) inches: Ductile iron body, stainless steel dual disc design, EPDM seat bonded to the valve body, 300 series stainless steel spring and shaft, AGS grooved ends equal to Victaulic Series W715.

G. Spring Loaded Check Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

a. Nibco
b. Crane
c. Dezurik
d. Haleson
e. Milwaukee Valve

2. Construction: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer, or threaded lug ends.

3. Two (2) and Smaller: Red bronze body, 301 stainless steel spring-actuated disc, EPDM o-ring, 300 series stainless steel stem and spring, in-line, lift-type check valve.

2.2 VIBRATION ISOLATION SUCTION & DISCHARGE HVAC PUMP DROPS – REQUIRED FOR ALL HVAC PUMPS

A. Manufacturer: Subject to compliance with plans and specification, provide the following:

1. Victaulic.

a. Victaulic Suction Vibration Isolation Pump drop **model # 381**.

b. Victaulic Discharge Vibration Isolation Pump drop **model # 380**.

Contact: Steven Johnson – (832) 986-7372 for sales assistance.

B. Suction Vibration Isolation Pump Drop **Model #381**:

1. Application:

a. Suction vibration isolation pump drop connects the water flow intake to the pumps.

b. Provides vibration isolation, noise reduction, expansion, contraction, and deflection.

c. A minimum of (3) three Victaulic flexible couplings are to be utilized to aid in vibration isolation, noise reduction, expansion, contraction, and deflection as shown in detail; a separate pipe vibration isolator is not required.

2. Victaulic Grooved Shut-off Butterfly Valve:

a. Grooved end butterfly valves two (2) inches to twelve (12) inches shall have a ductile iron body, electroless nickel-plated ductile iron disc, blowout proof 416 stainless steel stem, disc shall be offset from stem centerline to provide full 360-degree seating, EPDM seat and seal material, TFE lined fiberglass bearings, lever handle or gear operator with memory stop feature equal to Victaulic Vic-300 MasterSeal.

3. Victaulic Grooved Suction Diffuser:

a. Angle pattern, with flanged outlet and grooved inlet connections.

b. 175-psig pressure rating, ductile-iron body and end cap, pump-inlet fitting.

c. 20 mesh stainless steel, type 304 fine mesh startup pre-filter and 5/32” perforated type 304 stainless-steel permanent strainers.

d. Stainless-steel straightening guide vanes.

e. Drain plug, blow-down tapping in bottom, gage tapping on side.

f. Factory-fabricated adjustable foot support.

g. Provide bosses on either side for pressure measurement.

h. Permanent magnet located in flow stream removable for cleaning.

C. Discharge Vibration Isolation Pump Drop **Model #380**:

1. Application:

a. Discharge vibration isolation pump drop connects the pump to the interconnecting pipe / discharge header within the mechanical rooms.

b. Provides noise reduction, expansion, contraction, and deflection.

c. A minimum of (3) three Victaulic flexible couplings are to be utilized to aid in vibration isolation, noise reduction, expansion, contraction, and deflection as shown in detail; a separate pipe vibration isolator is not required.

2. Victaulic Grooved 90° Elbow Fitting:

a. Two (2”) - Twelve (12”) DN50 – DN300.
b. Fitting Material: Ductile iron conforming to ASTM A536, Grade 65-45-12.
c. Maximum Working Pressure: 400 psi.
d. Coating: Orange.

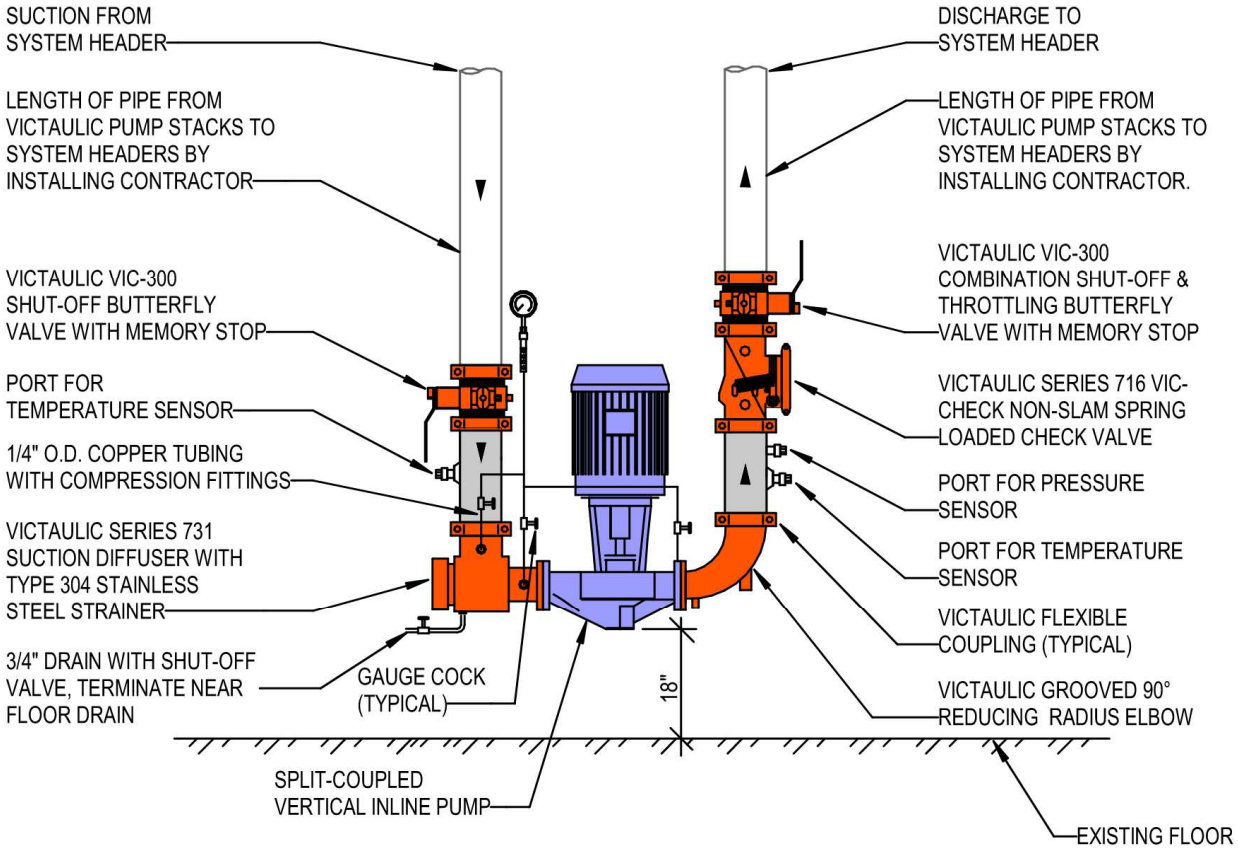
3. Victaulic Grooved Non-Slam Spring Loaded Check Valve:

   a. Two and a half (2-1/2) inches to twelve (12) inches: Ductile iron body, aluminum bronze or elastomer encapsulated ductile iron disc, stainless steel spring and shaft, welded-in nickel, or synthetic rubber seat with grooved ends equal to Victaulic Series 716.

4. Victaulic Grooved Shut-off Butterfly Valve:

   a. Grooved end butterfly valves two (2) inches to twelve (12) inches shall have a ductile iron body, electroless nickel-plated ductile iron disc, blowout proof 416 stainless steel stem, disc shall be offset from stem centerline to provide full 360-degree seating, EPDM seat and seal material, TFE lined fiberglass bearings, lever handle or gear operator with memory stop feature equal to Victaulic Vic-300 MasterSeal.

   b. Grooved end butterfly valves fourteen (14) inches to twenty-four (24) inches AGS grooved ends, polyphenylene sulfide (PPS) coated ductile iron body (ASTM A-536, Grade 65-45-12), PPS coated ductile iron disc (ASTM A-536), and two-piece 17-4 PH S/S stem design. Seat and seal material to suit intended service. Reinforced PTFE bearings and gear operator. Bubble tight, dead-end, or bi-directional service. With memory stop for throttling, metering, or balancing service. Victaulic Vic®-300 AGS.



CONTRACTOR SHALL DETERMINE FINAL LENGTH OF SUCTION AND DISCHARGE PIPING TO NEW PIPING HEADERS.

2.3 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe two (2) inches and Smaller:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze soldered or push-to-connect joints.

B. Flanges for Pipe two (2) inches and Larger:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.

C. Gaskets: 1/16-inch-thick preformed neoprene.

D. Grooved Joint Flange Adapters two (2) inches and Larger:

1. Ductile iron housing for use with grooved end pipe and fittings, flat face, for direct connection to flanges with ANSI Class 125 and 150 bolt hole patterns equal to Victaulic Style 741. For direct connection to flanges with ANSI Class 300 bolt hole pattern, use Victaulic Style 743.

E. Grooved Pipe End Couplings:

1. Housing: Two-piece ductile iron housing conforming to ASTM A-536, Grade 65-45-12.

2. Gasket: Synthetic rubber conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D-2000. operating temperature range from -30 degrees Fahrenheit to 250 degrees Fahrenheit.

3. Rigid type couplings shall have angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9 equal to Victaulic Style 107V.

4. Flexible type couplings shall be used where vibration attenuation and stress relief are required, equal to Victaulic Style 177.

F. Accessories: Stainless Steel bolts, nuts, and washers.

G. Dielectric Connections:

1. Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2. Waterway fitting with zinc electroplated steel or ductile iron body, threaded or plain end, water impervious isolation barrier.

3. Waterway fitting with zinc electroplated steel or ductile iron body, threaded or plain end, water impervious isolation barrier.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

B. Install valves with stems upright or horizontal, not inverted.

C. Use grooved mechanical couplings where approved by the engineer.

D. Install butterfly or ball shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

E. Install calibrated-orifice, balancing valves at each branch connection to return main.

F. Install globe or ball valves for throttling, bypass, or manual flow control services.

G. Provide spring loaded check valves on discharge of water pumps.

H. Provide flow controls in water re-circulating systems.

I. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

J. Use 1 1/4” inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

K. Install valves in accessible locations to permit removal of bonnet.

L. Install valve stems in vertical position. Valve stems installed in horizontal position shall be no less than 30 degrees from horizontal.

M. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved joint couplings and valves shall be supplied by a single manufacturer. The gasket style and elastomeric material shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A Victaulic factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

1. Install the grooved joint piping system in accordance with the latest manufacturer installation instructions. Pipe ends shall be clean and free from indentations and projections. Use manufacturer grooving tools with roll sets to groove the pipe. Follow manufacturer guidelines for tool selection and operation. Products shall not be installed with standard grooved end pipe or components. Installing products in combination with standard grooved end products could result in joint separation and/or leakage.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment roof curbs and support rails.
6. Sleeves.
7. Mechanical link seals.
8. Formed steel channel and angle.
9. Equipment bases and supports.
10. Portable roof pipe supports.

B. Related Sections:

1. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

2. Division 7 - Thermal and Moisture Protection.

1.3 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show fabrication and installation details and include calculations for the following: include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not apply Firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of Firestopping materials.

C. Provide ventilation in areas to receive solvent cured materials.

1.8 WARRANTY

A. Furnish one (1) year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Carpenter & Paterson Inc.
2. Flex-Weld, Inc.
3. Globe Pipe Hanger Products Inc.
4. Michigan Hanger Co.
5. B-Line Systems
6. Carpenter & Patterson Inc.
7. Anvil International
8. Piping Technology & Products
9. Grinnell

B. Hydronic Piping:
1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

2. Hangers for Cold Pipe Sizes two (2) inches and larger: Carbon steel, adjustable, clevis.

3. Hangers for Hot Pipe Sizes 2 inches to 4 inches: Carbon steel, adjustable, clevis.

4. Hangers for Hot Pipe Sizes six (6) inches and larger: Adjustable steel yoke, cast iron roll, double hanger.

5. Multiple or Trapeze Hangers: Galvanized Steel channels with welded spacers and hanger rods.

6. Multiple or Trapeze Hangers for Hot Pipe Sizes six (6) inches and larger: Galvanized Steel channels with welded spacers and hanger rods, cast iron rollers.

7. Wall Support for Pipe Sizes three (3) inches and smaller: Cast iron hooks.

8. Wall Support for Pipe Sizes four (4) inches and larger: Welded galvanized steel bracket and wrought steel clamp.

9. Wall Support for Hot Pipe Sizes six (6) inches and larger: Welded galvanized steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.

10. Vertical Support: galvanized Steel riser clamp.

11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

12. Floor Support for Hot Pipe Sizes four (4) Inches and smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

13. Floor Support for Hot Pipe Sizes six (6) inches and larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

14. Copper Pipe Support: Copper-plated, carbon steel ring.

15. Hydronic Piping shall not have support brackets welded to hydronic piping.

C. Roof Mounted Hydronic Piping:

1. Refer to Division 7 –for hanger requirements and approved manufacturers.

2.2 HANGER RODS

A. Hanger Rods: Hot dipped galvanized, mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. In accordance with Division 7 - Thermal and Moisture Protection.

2.5 HOODED CURB

A. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24-gauge stainless steel.

2.6 EQUIPMENT ROOF CURBS AND SUPPORT RAILS

A. Equipment roof curbs and support rails must be coordinated with roof type specified under Division 7.

B. Roof mounted exhaust fans, intake hoods, relief hoods and supply fans shall be set on equipment manufacturers 12” high fabricated welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick curb insulation, factory installed treated wood nailer. Curb shall set level on roof without the need for blocking.

C. Roof mounted unitary air conditioning units shall be set on a structural type of curb or equipment support rail. Curb or support rail shall be compatible with required vibration isolation specified under Section 23 05 48. Curb or support rail shall be 12” high welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick insulation, 3 lb. density, factory installed wood nailer and stainless-steel cap. Curb shall set level on roof without the need for blocking. Field bolted curbs are not acceptable.

D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. The Pate Co.
   b. Custom Curb, Inc.
   c. Roof Products, Inc.

E. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

2.7 SLEEVES

A. Sleeves for Pipes through fire rated or non-fire rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes through Rated or Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel.

E. Sealant: Refer to Section 07 92 00 - Building Sealants.

2.8 MECHANICAL LINK SEALS

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Thunderline Link-Seal / GPT.
2. Innerlynx.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.9 FORMED STEEL CHANNEL AND ANGLE

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Allied Tube & Conduit Corp.
2. B-Line Systems
3. Midland Ross Corporation, Electrical Products Division
4. Unistrut Corp.

B. Product Description: Galvanized 14 gage thick steel angle and galvanized 12 gage thick steel channel with holes 1-1/2 inches on center. Metal framing system for equipment support.

C. All channel members and angles shall be hot-dipped galvanized and fabricated from structural grade steel and conform to applicable ASTM specifications.

D. Structural members to be loaded within manufacturers design limitations and published data.

2.10 EQUIPMENT BASES AND SUPPORTS

A. In accordance with Division 3 – Concrete

B. Provide concrete equipment pads, reinforced with 6-inch x 6-inch welded wire mesh, chamfered edges and to be six (6) inches larger than base of equipment. Pad heights as follows:

1. Hot Water Boilers: four (4) inches.
2. Floor Mounted Pumps: four (4) inches.
3. Floor Mounted Water Volume Tanks: four (4) inches.
4. Air Handling Units: six (6) inches.
5. Water Heaters: four (4) inches.
6. Water Softeners: four (4) inches.
7. Air Compressor: four (4) inches.
8. Floor Mounted Expansion Tanks: four (4) inches.
9. Floor Mounted chemical feeder tanks: four (4) inches.
10. Floor Mounted Fans: four (4) inches.
11. Chillers: four (4) inches.
12. Condensing Units: four (4) inches.
13. Heat Pump Units: six (6) inches.
14. Dust Collectors: four (4) inches.
15. Plasma cutters: four (4) inches.

C. Provide vibration isolation in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.11 PORTABLE ROOF PIPE SUPPORTS

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Advanced Support Products (ASP)
2. PHP System Design

B. Steel and PVC Piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel, 4'-0" maximum intervals for PVC piping. Roof supports shall be provided with height adjustable crossbar and clevis hangers. Product specifications:

1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.

2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.

3. Height: Adjustable.

4. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.

5. Hardware: Corner brackets and leg brackets bolted with ½" x 2-1/2" bolt & ½" nut; frame bolted to support base with ½" x 2-1/2" bolts, ½" nuts and washers. Leg brackets and all thread rods, nuts and washers shall be hot- dipped galvanized.

6. Required accessories: ½" threaded rod, clevis hangers, strut clamps and protection pads.

C. Condensate disposal piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel condensate piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model REC-SA (Rubber EcoCurb) with channel. Product specifications:

1. Bases: 100% recycled Vulcanized Rubber with UV inhibitors.

2. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.

3. Hardware: ½" threaded rods (12" high); ½" nuts & washers, hot- dipped galvanized.

4. Height: Adjustable.

5. Required accessories: Strut clamps and protection pads.

6. Hot dipped galvanized threaded rods, nuts, and washers.

D. Protection pads: Provide protection pad sheets between the roof / grade and support system. Protection pads shall not be adhered to either the roof or the support system.

1. Material: Porous rubber.
2. Weight: 2 lbs.
3. Dimensions: 18" square X ½" thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive Firestopping/Firesafing.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of Firestopping material.

B. Remove incompatible materials affecting bond.

C. Install damming materials to arrest liquid material leakage.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Do not drill or cut structural members.

F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 STRUCTURAL STEEL

A. All structural steel used to fabricate supports shall conform to ASTM A36.

3.4 CUTTING AND PATCHING

A. In accordance with Division 7 - Thermal and Moisture Protection

3.5 FIRESTOPPING

A. In accordance with Division 7 - Thermal and Moisture Protection.

3.6 FIRESTOPPING ACCESSORIES

A. In accordance with Division 7 - Thermal and Moisture Protection.

3.7 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.1

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2-inch minimum vertical adjustment.

F. Support vertical piping at every other floor.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports.

L. Provide clearance in hangers and from structure and other equipment for installation of pipe insulation. Refer to Section 23 07 19 - HVAC Piping Insulation.

3.9 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum four (4) inches thick and extending six (6) inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.10 INSTALLATION - FLASHING

A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide curbs for mechanical roof installations 12 inches minimum above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

C. Adjust storm collars tight to pipe with bolts, caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

D. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

3.11 INSTALLATION - SLEEVES

A. Provide sleeves at all piping and ductwork penetrations of interior walls and slabs. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors two (2) inches above finished floor level. Caulk sleeves.

E. Extend sleeves through walls two (2) inches each side.

F. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with Firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install stainless steel escutcheons at finished surfaces.

3.12 INSTALLATION - FIRESTOPPING

A. Install material at all fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items.

B. Apply primer where recommended by manufacturer for type of Firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply Firestopping material in sufficient thickness to achieve required fire and smoke rating.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Fire Rated Surface:

1. Seal opening at floor, wall, and partition as follows:

   a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.

   b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.

   c. Pack void with backing material.

   d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

F. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall and partition floor as follows:

a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.

b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.

2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

4. Interior partitions: Seal pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.13 INSTALLATION - ACCESS DOORS

A. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts, and other apparatus where concealed. Access doors shall have concealed hinges and screwdriver cam locks. Minimum size to be 12 inches x 12 inches in walls only for hand access and 24 inches x 24 inches minimum for all ceilings for maintenance access.

B. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.

C. Access Doors:

1. Plastic Surfaces: Milcor Style K.
2. Ceramic Tile Surface: Milcor Style M.
3. Drywall Surfaces: Milcor Style DW.
4. Install panels only in locations approved by the Architect and with trim styles and color coordinated with surface to be installed in.

3.14 INSTALLATION – EQUIPMENT REQUIRING ROOF PORTALBE BASES

A. Verify that roof surface is smooth and clean to extent needed to receive material.

B. Clean surfaces to receive 17” circular bases removing any loose gravel and foreign matter before setting 17” circular bases.

C. Provide protective pad conforming to the new or existing roof manufacturer’s system under each 17” circular bases. Do not adhere to the roof system or to circular bases.

3.15 FIELD QUALITY CONTROL

A. Inspect installed Firestopping for compliance with specifications and submitted schedule.

3.16 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.17 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.18 PIPE HANGERS

A. Minimum hanger rod size shall be ½".

B. Maximum hanger rod spacing shall not exceed 10'-0" on center for pipe sizes 2" and above. Do not exceed 7'-0" hanger spacing for pipes sizes less than 2" diameter.

C. For trapeze supports provide a minimum of (2) two ½" hanger rods at each end of trapeze for a total of (4) four for pipes 10" or larger.

D. Beam clamps are not acceptable.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Vibration isolation for building mechanical systems.

B. Related Sections:

1. Section - 23 05 16 - Expansion Fittings and Loops For HVAC Piping
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

C. Mason Industries model numbers are listed for identification only.

D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Mason Industries
2. Kinetics Noise Control
3. Amber / Booth
4. VMC
5. Vibration Eliminator
6. Vibro-Acoustics

1.3 PERFORMANCE REQUIREMENTS

A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.

B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.

C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.

D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35-inch deflection.

E. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and anti-oxidant additives.

F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts, and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs/sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.

H. Air handling equipment subjected to excessive horizontal air thrust operating at three (3) inches S.P. shall be furnished with Type WBI/WBD isolated thrust resisters to limit displacement to 1/4 inch.

I. Height savings brackets used with isolators having 2.5-inch deflection or greater shall be of the precompression type to limit exposed bolt length.

J. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.

K. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.

L. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.

M. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.

1. Offices
   Executive: 30
   Conference rooms: 30
   Private: 35
   Open-plan areas: 35
   Computer/business machine areas: 40
   Public circulation: 40

2. Schools
   Lecture and classrooms: 30
   Open-plan classrooms: 35

3. Libraries: 25

4. Theaters
   Theater: 25
   Stage house: 25
   Trap room: 25
   Orchestra pit: 25
   Rehearsal rooms: 25
   Teaching studios: 30
   Practice rooms: 30
   Ensemble rooms: 30
   Shop: 45

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.

C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.

D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.

E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.

1.5 QUALITY ASSURANCE

A. The vibration isolation manufacturer, or qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Vibration isolation manufacturer shall also inspect vibration isolation in units with factory provided isolation in order to confirm scheduled deflection and isolator type is in accordance with this specification. Upon completion of the installation and after the system is put into operation, the manufacturer, or representative, shall make a final inspection and submit his report to the Architect and Engineer in writing certifying the correctness of installation and compliance is in accordance approved submittal data.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.

A. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

B. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small

vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.

C. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

D. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.

E. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.

F. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers, nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.

G. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

H. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.

I. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure

that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.2 BASES

A. Type WF: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.

C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where space is a problem. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2 inches above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

2.3 FLEXIBLE PIPE CONNECTIONS (CHILLERS AND BASE-MOUNTED PUMPS)

A. Type SFDEJ, SFEJ, SFDCR or SFU with Control Rods CR (required): Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14"shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14"shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping

gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2"thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

B. Isolators shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.5 hp and over per the isolation schedule and these specifications.

3.2 PIPING ISOLATION

A. Horizontal Pipe Isolation: All pumped water, pumped condensate, and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1” inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.

B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

A. Comply with manufacturer’s instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.

B. Locate isolation hangers as near the overhead support structure as possible.

C. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

D. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.

E. Install Work in accordance with ASME B31.9.

F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.

G. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.

H. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

I. Contractor shall install load distribution plates provided by vibration isolation manufacturer on WSW type isolators. Plates shall be aligned with isolation pad.

EQUIPMENT ISOLATION SCHEDULE

EQUIPMENT	LOCATION					
	ELEVATED STRUCTURE			SLAB ON GRADE		
	ISOLATOR TYPE	MINIMUM DEFLECTION (Inches)	BASE (1) TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (Inches)	BASE (1) TYPE
AIR HANDLING UNITS (NOTE 2)						
FLOOR MOUNTED	SLF	0.75	-	SLF	0.75	-
TO 15 HP	SLF	1.5	-	SLF	0.75	-
20 HP & OVER						
SUSPENDED	30N	1	-	30N	1	-
UP TO 15 HP	PC30N	1.75	-	PC30N	1	-
20 HP & OVER						
HIGH PRESSURE FAN	SLF/W	1.5	RBMK	SLF/W	0.75	RBMK
SECTION (NOTE 1)	BI	2.5	RBMK	BI	1.5	RBMK
UP TO 30 HP	SLF/W			SLF/W		
40 HP & OVER	BI			BI		
CENTRIFUGAL FANS						
CL. I & II UP TO 54-1/2” W.D.						
Up to 15 HP	SLF	0.75	WF	SLF	0.75	WF
20-50 HP	SLF	1.5	RBMK	SLF	0.75	WF
60 HP & OVER	SLF	2.5	RBMK	SLF	1.5	WF
CL. I & II 60" W.D. & OVER/ALL						
CL. III FANS UP TO 15 HP	SLF/W	1.5	RBMK	SLF/W	0.75	RBMK
20-50 HP	BI	2.5	RBMK	BI	1.5	RBMK
60 HP & OVER	SLF/W	2.5	RBMK	SLF/W	1.5	RBMK
	BI			BI		
	SLF/W			SLF/W		
	BI			BI		
AXIAL-FLOW FANS (NOTE 1)						
FLOOR MTD.						
UP TO 15 HP	SLF	0.75	-	SLF	0.75	-
20 HP & OVER	SLF	1.5	-	SLF	0.75	-
SUSPENDED (NOTE 1)						
UP TO 15 HO	30N	1	-	30N	1	-
20 HP & OVER	PC30N	1.75	WF	PC30N	1.5	-

VENT (UTILITY SETS)						
FLOOR MTD.	SLF	0.75	-	SLF	0.75	-
SUSPENDED	30N	1	-	30N	0.75	-
CABINET FANS, FAN SECTIONS (NOTE 1)						
CL. I & II UP TO 54-1/2" W.D.	SLF	0.75	-	SLF	0.75	-
Up to 15 HP	SLF	1.5	-	SLF	0.75	-
20-50 HP						
SUSPENDED	30N	1	-	30N	0.75	-
UP TO 15 HP	PC30N	1.75	-	30N	1.75	-
20 HP & OVER						
PUMPS						
FLOOR MTD. UP TO 60 HP	SLF	1.50	RBMK	SLF	0.75	RBMK
FLOOR MTD. 75 HP AND LARGER	SLF	2.50	RBMK	SLF	0.75	RBMK
SUSPENDED INLINE	PC30N	1.75	-	PC30N	1.75	-
REFRIGERATION UNITS						
RECIPROCATING	SLF	1.5	RBMK	SLF	0.75	RBMK
COMPRSSORS	SLR/IC	1.5	-	SLF	0.75	-
RECIPROCATING COND.	S	1.5	-	WSW	0.15	-
UNITS & CHILLERS	SLR	1.5	RBMK	WSW	0.15	-
HERMETIC	SLF	0.75	-	WSW	0.15	-
CENTRIFUGALS	SLR/IC					
OPEN CENTRIFUGALS	S					
ABSORPTION MACHINES						
AIR COMPRESSORS						
TANK TYPE (HORIZONTAL	SLF	1.5	-	SLF	0.75	-
TANK)	SLF	1.5	-	SLF	0.75	-
TANK TYPE (VERTICAL TANK)						
COOLING TOWERS &						
CLOSED-CIRCUIT COOLERS	SLR	0.75	(1)	WSW	0.15	-
UP TO 500 TONS	SLR	2.5	(1)	WSW	0.15	-
OVER 500 TONS						
AIR COOLED CONDENSERS						
UP TO 50 TONS	SLR	0.75	(1)	WSW	0.15	-
OVER 50 TONS	SLR	1.5	(1)	WSW	0.15	-
ROOFTOP AIR CONDITIONING UNITS						
REQUIRING WEATHER	SLF	0.75	RSC/C	-	-	-
SEAL	SLR	1.5	MAB	-	-	-
UP TO 5000 CFM (12 TON)			RSC/C			
OVER 5000 CFM (12 TON)	SLR	1.5	MAB	-	-	-
OTHER TYPES	SLR	1.5		-	-	-
UP TO 25 TONS			(1)			
OVER 25 TONS			(1)			
BOILER (PACKAGE TYPE)						
ALL SIZES	SLR	0.75		WSW	0.15	-
ENGINE DRIVEN GENERATORS	SLR	1.5	RBMK	SLR	0.75	-
UP TO 60 HP	SLR	2.5	RBMK	SLR	0.75	-
75 HO & OVER						

Notes:

1. Provide steel base type WF if equipment requires base frame or does not include integral base rail for vibration isolation.

2. Provide WSW isolator type with load distribution plate for floor mounted AHU's that are internally isolated. Isolation deflection and type specified refers to factory isolation requirements.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.
8. Pipe painting (if required)

B. Related Sections:

1. Section 09 91 00 - Painting and Staining.

C. Color scheme for identification must be coordinated with district standards. Color scheme specified is bases of design if required for project. Contractor shall confirm painting requirements with Architect/District.

1.3 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.
2. District Standards for identification and color scheme.

1.4 SUBMITTALS

A. Product Data: Submit manufacturers catalog literature for each product required.

B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Identify painting requirements as directed by Architect/District. Contractor to confirm if painting of piping is required for project. Contractor shall provide primer coat on un-insulated outdoor condenser water piping as a minimum.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

B. Conform to ANSI / OSHA Pipe Marking Specifications.

C. Specification is not limited to manufacturers listed. Substitutions are allowed in accordance with Division 1 - General Requirements and Division 23, Section 23 05 00 - Common Work Results for HVAC.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Almetek Industries.
e. Marking Services, INC. (MSI).
f. Brimar.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches.

B. Metal Tags:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

    a. Craftmark Identification Systems.
    b. Safety Sign Co.
    c. Seton Identification Products.
    d. Almetek Industries.
    e. Marking Services, INC. (MSI).
    f. Brimar.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

C. Information Tags:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

    a. Craftmark Identification Systems.
    b. Safety Sign Co.
    c. Seton Identification Products.
    d. Almetek Industries.
    e. Marking Services, INC. (MSI).
    f. Brimar.

2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

D. Tag Chart: Typewritten letter size list of applied tags and location in plastic laminated chart to indicate valve make, size, model, and service.

2.3 STENCILS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Stencils: With clean cut symbols and letters of following size:

1. Up to two (2) inches Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.

2. 2-1/2 to six (6) inches Outside Diameter of Insulation or Pipe: one (1) inch high letters.

3. Over six (6) inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.

4. Ductwork and Equipment: 1-3/4 inches high letters.

C. Stencil Paint: As specified in Section 09 91 00 Paintings and Staining, semi-gloss enamel, colors, and lettering size in conformance with ASME A13.1.

2.4 PIPE MARKERS

A. Plastic Pipe Markers:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.
   d. Almetek Industries.
   e. Marking Services, INC. (MSI).
   f. Brimar.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

B. Plastic Tape Pipe Markers:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.
   d. Almetek Industries.
   e. Marking Services, INC. (MSI).
   f. Brimar.

2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

C. Plastic Underground Pipe Markers:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.
   d. Almetek Industries.
   e. Marking Services, INC. (MSI).
   f. Brimar.

2. Bright colored continuously printed plastic ribbon tape, minimum six (6) inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.
2. Safety Sign Co.

3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Description: Steel with 3/4-inch diameter color-coded head.

2.6 LABELS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Almetek Industries.
e. Marking Services, INC. (MSI).
f. Brimar.

2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Almetek Industries.
e. Marking Services, INC. (MSI).
f. Brimar.

2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 91 00 Paintings and Staining for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting in accordance with Section 09 91 00 Paintings and Staining.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain or 4 ply 0.018 smooth copper wire. Tags shall be numerically sequenced with all valves of each system type grouped together.

F. Install underground plastic pipe markers six (6) to eight (8) inches below finished grade, directly above buried pipe.

G. All exterior visible piping shall be identified with UV and acid resistant outdoor pipe markers.

H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.

I. Identify control panels and major control components outside panels with plastic nameplates.

J. Identify air terminal units and radiator valves with numbered tags.

K. Tag automatic controls, instruments, and relays. Key to control schematic.

L. Identify insulated piping, concealed, or exposed indoor with plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Use plastic pipe UV protected markers on exterior piping. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Coordinate with Architect.

N. Identify un-insulated piping with plastic pipe markers. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

3.3 IDENTIFICATION SCHEDULE

A. Markers shall be colored as indicated below per ANSI/OSHA Standards OR as specified in District Standards:

SYSTEM	COLOR	LEGEND
Chilled Water	Green	Chilled Water Supply Chilled Water Return
Domestic Water	Green	Domestic Water
Domestic Hot Water Supply	Yellow	Domestic Hot Water Supply
Domestic Hot Water Return	Yellow	Domestic Hot Water Return
Fire Protection	Red	Fire Protection
Automatic Sprinkler	Red	Fire Sprinkler
Gas	Yellow	Natural Gas
Condenser Water	Green	Condenser Water Supply
		Condenser Water Return

B. PIPE PAINTING:

1. All piping exposed to view in conditioned spaces shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections and painting requirements with Architect/District prior to installation.

2. The entire fire protection piping system shall be painted red.

3. All outdoor un-insulated piping shall be painted with primer as a minimum.

4. All piping located in mechanical rooms and outdoor piping shall be painted as indicated in Painting Schedule. Painting requirement must be confirmed by contractor.

C. PAINTING SCHEDULE

SYSTEM	COLOR
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange
Condenser Water Supply and Return	Light Green
Gas	Yellow
Chilled Water Supply and Return	Light Blue
Heating Hot Water supply and Return	Reddish Orange

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Testing, adjusting, and balancing of air systems.
2. Testing, adjusting, and balancing of Hydronic piping systems
3. Testing, adjusting, and balancing of refrigerating systems.
4. Measurement of final operating condition of HVAC systems.
5. Sound measurement of equipment operating conditions.
6. Vibration measurement of equipment operating conditions.

B. Related Sections:

1. Sequences of operation for HVAC equipment as scheduled on Drawings.

C. Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to Owner. TAB contractor shall not be hired by general contractor or any sub-contractor.

D. Mechanical contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.

E. TAB Contractors:

1. Engineered Air Balance
2. Precision Air

1.3 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

C. Natural Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

C. Engineer and Technicians Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.

D. Procedures and Agenda: Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed to be used for this project.

E. Sample Forms: Submit sample forms, if other than those standard forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.

F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of hoe the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:

1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit two (2) complete sets of draft reports. Only one (1) complete set of draft reports will be returned.

2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit two (2) complete sets of final reports.

3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binder. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs.

    a. General Information and Summary
    b. Air Systems
    c. Refrigerant Systems
    d. Temperature Control Systems
    e. Special Systems.

4. Report Contents: Provide the following minimum information, forms and data:

    a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Engineer, and Project.

Include addresses and contact names and telephone numbers. Also include a certification sheet containing the seal name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six (6) months prior to starting the project.

1.5 QUALITY ASSURANCE

A. Test and Balance Engineer's Qualifications: A Professional Engineers registered in the State in which the services are to be performed and having at least three (3) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.

B. Agency Qualifications:

1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to the test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.

2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.

C. Codes and Standards

1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

2. AABC: "National Standards for Total System Balance."

3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.

D. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of installers of the mechanical systems. The objective of the conference is final

coordination and verification of the system operation and readiness for testing, adjusting, and balancing.

1.6 PROJECT CONDITIONS

A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.7 SEQUENCING AND SCHEDULING

A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.

B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five (5) degrees Fahrenheit wet bulb temperature of maximum summer design condition, and within ten (10) degrees Fahrenheit dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.

C. Notice: Provide minimum 7 days advanced notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SERVICES OF THE MECHANICAL CONTRACTOR

A. Examine the contract documents to become familiar with Project requirements and to discover conditions in systems design that may preclude proper TAB of systems and equipment.

B. Examine the approved submittals for HVAC systems and equipment.

C. Verify systems are complete and operable before commencing work. Verify the following:

1. Systems are started and operating in safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed, and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.

14. Proper strainer baskets are clean and in place or in normal position.
15. Service and balancing valves are open.
16. Re-sheave

D. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.

E. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.

F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.

G. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR

A. Furnish instruments required for testing, adjusting, and balancing operations.

B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

C. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 INSTALLATION TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%

2. Air Outlets and Inlets: +/- 5%

3. Heating-Water Flow Rate: +/- 5%

4. Cooling-Water Flow Rate: +/- 5%

3.4 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

D. Report defects and deficiencies noted during performance of services, preventing system balance.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries in clean rooms.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from construction manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

A. Verify that the cooling coil is capable of full-system airflow and set mixing boxes at full-cold airflow position for fan volume.

B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

1. If insufficient static pressure exists, increase airflow at the fan.

C. Test and adjust the constant-volume mixing boxes as follows:

1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.

2. Verify sufficient inlet static pressure before making volume adjustments.

3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.

D. Do not over pressurize ducts.

E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    b. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.

2. Set terminal units and supply fan at full-airflow condition.

3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

4. Readjust fan airflow for final maximum readings.

5. Measure operating static pressure at the sensor that controls the supply fan if one is installed and verify operation of the static-pressure controller.

6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.

7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.

3. Set terminal units at full-airflow condition.

4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Adjust terminal units for minimum airflow.

6. Measure static pressure at the sensor.

7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

A. Set unit at maximum airflow through the cooling coil.

B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.

2. Check liquid level in expansion tank.

3. Check makeup water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation and set at indicated flow.

5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.

6. Set system controls so automatic valves are wide open to heat exchangers.

7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner/Engineer and comply with requirements in "Hydronic Pump Specification."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

    a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated pre-settings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR DOMESTIC HOT WATER SYSTEMS

A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.

B. Preparation of the hot water system for balancing:

1. Confirm outlet temperature of the system at water heaters and/or storage tanks.

2. Verify recirculation pump operation and rotation.

3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.

C. The test and balance report shall indicate the following:

1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.

2. Pressure, temperature and flow in gpm at the suction side of each circulating pump.

3.15 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check settings and operation of safety and relief valves. Record settings.

3.16 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove

proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.17 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.

2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.

3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.

4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.

5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.

6. Capacity: Calculate in tons of cooling.

7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.18 PROCEDURES FOR COOLING TOWERS

A. A complete Factory CTI certified test of the cooling tower will be performed at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB report. Balance the flow over and through bypass connections of the tower.

3.19 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.20 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.

2. Measure motor voltage and amperage. Compare the values to motor nameplate information.

3. Check the refrigerant charge.

4. Check the condition of filters.

5. Check the condition of coils.

6. Check the operation of the drain pan and condensate-drain trap.

7. Check bearings and other lubricated parts for proper lubrication.

8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.

2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

4. Balance each air outlet.

3.22 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.

15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat-coil static-pressure differential in inches wg (Pa).
g. Cooling-coil static-pressure differential in inches wg (Pa).
h. Heating-coil static-pressure differential in inches wg (Pa).
i. Outdoor airflow in cfm (L/s).
j. Return airflow in cfm (L/s).
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.
    e. Fin spacing in fins per inch o.c.
    f. Make and model number.
    g. Face area in sq. ft
    h. Tube size in NPS (DN).
    i. Tube and fin materials.
    j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

    a. Air flow rate in cfm (L/s).
    b. Average face velocity in fpm (m/s).
    c. Air pressure drop in inches wg (Pa).
    d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
    e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
    f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
    g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
    h. Water flow rate in gpm (L/s).
    i. Water pressure differential in feet of head or psig (kPa).
    j. Entering-water temperature in deg F (deg C).
    k. Leaving-water temperature in deg F (deg C).
    l. Refrigerant expansion valve and refrigerant types.
    m. Refrigerant suction pressure in psig (kPa).
    n. Refrigerant suction temperature in deg F (deg C).
    o. Inlet steam pressure in psig (kPa).

G. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Fuel type in input data.
    g. Output capacity in Btu/h (kW).
    h. Ignition type.
    i. Burner-control types.
    j. Motor horsepower and rpm.
    k. Motor volts, phase, and hertz.
    l. Motor full-load amperage and service factor.
    m. Sheave make, size in inches, and bore.
    n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

    a. Total air flow rate in cfm (L/s).

b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg (Pa).
f. Leaving-air static pressure in inches wg (Pa).
g. Air static-pressure differential in inches wg (Pa).
h. Low-fire fuel input in Btu/h (kW).
i. High-fire fuel input in Btu/h (kW).
j. Manifold pressure in psig (kPa).
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h (kW).
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h (kW).

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h (kW).
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Air flow rate in cfm.
i. Face area in sq. ft.
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h (kW).
b. Air flow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg (Pa).
   c. Fan rpm.
   d. Discharge static pressure in inches wg (Pa).
   e. Suction static pressure in inches wg (Pa).

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

   a. System and air-handling-unit number.
   b. Location and zone.
   c. Traverse air temperature in deg F.
   d. Duct static pressure in inches wg (Pa).
   e. Duct size in inches.
   f. Duct area in sq. ft.
   g. Indicated air flow rate in cfm.
   h. Indicated velocity in fpm.
   i. Actual air flow rate in cfm.
   j. Actual average velocity in fpm.
   k. Barometric pressure in psig (Pa).

K. Air-Terminal-Device Reports:

1. Unit Data:

   a. System and air-handling unit identification.
   b. Location and zone.
   c. Apparatus used for test.
   d. Area served.
   e. Make.
   f. Number from system diagram.
   g. Type and model number.
   h. Size.
   i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

   a. Air flow rate in cfm.
   b. Air velocity in fpm.
   c. Preliminary air flow rate as needed in cfm.

d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig (kPa).
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).

h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

N. Vibration Test:

1. Location of points:

a. Fan bearing, drive end
b. Fan bearing, opposite end
c. Motor bearing, center (when applicable)
d. Motor bearing, drive end
e. Motor bearing, opposite end
f. Casing (bottom or top)
g. Casing (side)
h. Duct after flexible connection (discharge)
i. Duct after flexible connection (suction)

2. Test readings:

a. Horizontal, velocity and displacement
b. Vertical, velocity and displacement
c. Axial, velocity and displacement
d. Normally acceptable readings, velocity and acceleration
e. Unusual conditions at time of test
f. Vibration source (when non-complying)

O. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

B. Section Includes: Insulation systems for sheet metal duct conveying cold, hot, and grease laden air.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Provide duct insulation systems which have been manufactured, fabricated, and installed to meet all thermal requirements of mechanical systems. Insulating systems shall be installed in strict accordance with manufacturer's field requirements and the current International Energy Conservation Code including all local amendments and criteria specified herein.

B. Performance Requirements: Provide duct insulation systems which have been manufactured and installed to meet the following standards:

C.

1. NFPA 90A.
2. NFPA 90B.
3. UL 723, ASTM E84: Flamespread 25, smoke developed 50.
4. ASTM C1136: 150 degrees F.
5. ASTM C1290.
6. UL 181 for Class I Air Duct.
7. NAIMA AHS-152T.

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work

C. Submit manufacturer's product data and installation instructions.

D. Provide drawings indicating typical duct insulation details, thickness and location. Identify areas and required insulation.

E. Manufacturer's certificate that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.

B. Condensation on any insulated system is not acceptable. Contractor shall replace insulation deemed unacceptable due to exposure to condensation at no additional cost to project.

C. Insulation to provide minimum R-value in accordance with current International Energy Conservation Code including all local amendments and criteria specified herein.

1.6 DELIVERY, STORAGE & HANDLING

A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.

B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – MUST BE MANUFACTURED AND BRANDED BY ONE OF THE FOLLOWING:

A. Fiber Glass Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Owens Corning
2. Johns Manville
3. CertainTeed
4. Knauf brand Insulation

B. Mastics and Adhesive: Subject to compliance with plans and specification, provide one of the following:

1. Childers
2. Foster
3. Vimasco

C. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:

1. Perma Glass
2. Alpha Glass
3. Childers
4. Vimasco

D. Fire Wrap Insulation: Subject to compliance with plans and specification, provide one of

the following:

1. 3M Fire Barrier Duct Wrap
2. Vesuvius Pyroscat Duct Wrap
3. Unifrax Corporation

2.2 DUCT WRAP

A. Material: Resilient blanket of fiberglass insulation factory laminated to foil/kraft vapor retarder facing.

B. Density: 0.75 pounds per cubic foot.

C. Installed minimum R value: 8.3.

D. Nominal Thickness: 3.0 inches.

E. Installed Thickness: 2-1/4 inches.

F. Installed Thermal Conductivity (compressed): k = 0.27

G. Operating Temperature (ASTM C411): up to 250° Fahrenheit.

H. Insulation Jacket Temperature Limit (ASTM C1136): up to 150° Fahrenheit.

I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120° Fahrenheit, 95% RH.

J. Testing Method 1338: Fungi Resistance Comply with requirements.

K. ASTM 665 Mineral Fiber Thermal Insulation: Comply with requirements.

L. Surface Burning Characteristics (ASTM E84): Flame spread 25, smoke developed 50.

2.3 ACOUSTICAL FLEXIBLE DUCT LINER:

A. Material: Acoustical insulation applied to interior of sheet metal ducts. Semi-rigid board of glass fibers with a tough, fire-resistant, anti-microbial, acrylic coating on the airstream side. Factory applied edge coating. Duct liner for rectangular and round duct as required.

A. Density: 1.5 pounds per cubic foot.

B. Installed minimum R value: 6.3.

C. Thickness: 1-1/2 inches.

D. Thermal Conductivity k, (ASTM C518): 0.24

E. Acoustic Performance: Sound absorption coefficients at octave band center frequencies (Hz)

Freq. (Hz)	125	250	500	1K	2K	4K	NRC
TL (dB)	0.19	0.55	0.84	1.0	1.0	.98	.85

F. Material Standards: Comply with NFPA 90A, NFPA 90B, and ASTM C1071.

G. Operating Temperature (ASTM C411): 250 degrees Fahrenheit.

H. Maximum Air Velocity (UL 181 Erosion test ASTM C1071): 6,000 fpm.

I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120°F, 95% RH.

J. Fungi Resistance (ASTM C1338 & G21): Comply with requirements.

K. Bacteria Resistance (ASTM G22): Comply with requirements.

L. Corrosiveness (ASTM C665): Will not cause corrosion greater than that caused by sterile cotton on aluminum or steel.

M. Surface Burning Characteristics (ASTM E84, UL 723): Flame spread 25, smoke developed 50.

2.4 GREASE EXHAUST DUCT

A. 1-1/2-inch-thick refractory ceramic blanket or calcia, magnesia and silica with aluminum foil, fiberglass-reinforced scrim encapsulation.

B. Product to be UL Listed as a two (2) hour duct enclosure.

C. Product shall be tested in accordance with the following:

1. ASTM G 411
2. ASTM C 51
3. ASTM E 84
4. ASTM E 119
5. ASTM E 136
6. ASTM E 814
7. UL 1978 Sections 12 and B

2.5 ACCESSORIES

A. Pressure-Sensitivity Aluminum Foil Tapes:

1. Material Standard: Listed and labeled under UL 181A, Part I, identified by name, date of manufacture, product name/number and UL 181A.
2. Size: At least 2-1/2 inches wide.

B. Heat-Activated Tapes:

1. Material Standard: Listed and labeled under UL 181A, Part II, identified by name, date of manufacture, product name/number and UL 181A, may be used in all applications except for bonding to sheet metal.

2. Size: At least three (3) inches wide.

C. Mastic and Glass Fabric System:

a. Material Standard: Listed and labeled under UL 181A, Part III.
b. Size: At least three (3) inches wide.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions and recommendations of the duct insulation manufacturer.

3.2 INSTALLATION

A. ACOUSTICAL LINING OF SHEET METAL DUCT AND FITTINGS:

1. Completely cover all portions of duct designated to receive duct liner with duct liner material. Neatly butt all transverse joints with no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.

2. Affix duct liner to the sheet metal with 90 percent coverage of adhesive complying with the requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication.

3. Secure duct liner with mechanical fasteners, either weld-secured or impact-driven. Compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted. Space mechanical fasteners with respect to duct liner interior width as follows:

    a. Maximum spacing for mechanical fasteners where air velocity is 0 – 2,500 FPM is as follows:

        1. From transverse end of liner: three (3) inches.
        2. Across width of duct: 12 inches on center.
        3. From corners of duct: four (4) inches.
        4. Along length of duct: 18 inches on center.

    b. Maximum spacing for mechanical fasteners where air velocity is 2,501 – 5,000 FPM is as follows:

        1. From transverse end of liner: three (3) inches.
        2. Across width of duct: six (6) inches on center.
        3. From corners of duct: four (4) inches.
        4. Along length of duct: 16 inches on center.

4. Provide galvanized metal clips on all leading edges of duct liner. Exposed insulation is not acceptable.

5. Cut duct liner to ensure overlapped and compressed longitudinal corner joints.

6. Cut duct liner board to ensure tight, overlapped corner joints. Support the top pieces of liner board at the edges by the side pieces.

7. If the specification requires use of multiple insulation layers, take the following additional steps:

    a. Affix bottom layer of duct liner in normal manner.

    b. Affix top layer of duct liner to bottom layer using a minimum of 90% adhesive coverage.

    c. Treat the leading edges of the duct liner with galvanized angle clips to prevent separation of the 2 layers.

    d. Use mechanical fasteners of the proper length for the double layer.

8. Application: Provide duct liner as follows:

   a. Provide duct liner in first 10 feet of duct from roof mounted exhaust fans.
   b. Provide duct liner in all return air boots and transfer ducts.
   c. Provide duct liner in the first 20 feet of supply and return duct from roof mounted air handling units / roof top units.

B. THERMAL INSUALTION WRAP ON DUCT AND FITTINGS:

1. Before applying duct wrap, air ducts must be clean, dry, and tightly sealed at all joints and seams.

2. All portions of duct designated to receive duct wrap shall be completely covered with duct wrap.

3. To ensure installed thermal performance, duct wrap insulation shall be cut to “stretch-out” dimensions as shown in tables in manufacturer’s literature.

4. Remove a two (2) inch piece of insulation from the facing at the end of the piece of duct wrap to form an overlapping stapling and taping flap.

5. Install duct wrap insulation with facing outside so that the tape flap overlaps the insulation and facing at the other end of the piece of duct wrap. Adjacent sections of duct wrap insulation shall be tightly butted with the two (2) inch stapling and taping flap overlapping. On rectangular duct, install so insulation is not excessively compressed at corners. Staple seams approximately six (6) inches on center with 1/2-inch minimum steel outward clinching staples.

6. Seal seams and joints with glass fabric and mastic. Do not use cloth duct tape of any color or finish using reclaimed rubber adhesives on duct wrap insulation. Tightly butt adjacent sections of duct wrap with the two (2) inch tape flap overlapping.

7. Where rectangular ducts are 24 inches in width or greater, additionally secure duct wrap insulation to the bottom of the duct with mechanical fasteners such as pins and speed clip washers or cuphead weld pins, spaced on 18-inch centers (maximum) to prevent sagging of insulation. Do not overly compress insulation.

8. Seal all tears, punctures and other penetrations of the duct wrap facing using glass fabric and mastic.

9. Application: Provide duct wrap as follows:

   a. All supply duct

   b. All outside air supply and intake duct

   c. All return air duct

   d. All return air plenums on air units

   e. All intake plenums on outside air handling units

   f. All ductwork routed in un-conditioned spaces including but not limited to un-conditioned plenums (non-return air plenums), attics, exterior soffits, ventilated mechanical/boiler rooms and crawl spaces.

C. GREASE EXHAUST DUCT AND FITTINGS:

1. Provide one (1) or two (2) layers of Ductwrap to create a 2-hour rated duct enclosure. Each layer shall be lapped a minimum of three (3) inches. Inner layer shall be held in place with one (1) inch wide filament tape, spaced 1-1/2 inch from edges and midway at 10-1-2 centers. The outer layer shall be offset by 10-1/2 inches of inner layer, and one (1) inch wide filament tape shall be used in same manner as inner layer. 1/2-inch x 0.015-inch carbon steel banding strips on shall be installed same dimensions as tape to secure both layers on duct. All horizontal and vertical support hangers shall be wrapped with 1-layer of fire rated duct wrap and be secured with stainless steel ties or 1/2-inch hose clamps.

2. Access Door Installation: Four galvanized steel threaded rods, 1/4-inch diameter by 5 inches long are to be welded to the duct at the corners of the door opening. Four steel tubes, each 3 inches long, are placed over the rods to act as protection for the duct wrap when fastening the door. Four insulation pins are to be welded to the door panel for installation of the blanket. One layer of duct wrap is cut approximately the same size as the access panel and impaled over the insulation pins on the panel. It is essential that this layer fit tightly against the wrap surrounding the access door opening with no through openings. A second layer of duct wrap is cut to overlap the first layer by a minimum of one (1) inch. The second layer is impaled over the pins and both layers are locked in place with galvanized speed clips. Pins that extend beyond the outer layer of duct wrap shall be turned down to avoid sharp points. The insulated door panel is placed over the threaded rods and held in place with washers and wing nuts. Provide an access door at each change in duct direction and a minimum of every 10 feet on straight duct.

3. Filament tape can be used to temporarily hold the blanket in place until the banding is applied. The steel banding is applied around the duct 1-1/2 inch from edge of the blanket, and maximum 10-1/2-inch centers. The banding is placed around the material and tightened so as to sufficiently hold the duct wrap in place against the duct, compressing the foil but not cutting the foil.

4. Additional Pinning to Prevent Sagging of Wrap: For ducts 24 inches and larger in width, additional pins are needed to support the blanket on the bottom horizontal surface and on the outside face of a vertical duct run. Space pins a maximum of 10-1/2 inches apart in the direction of the blanket width, and a maximum of 12 inches apart in the direction of the blanket length.

5. Provide 12 ga copper-coated steel insulation pins with 1.5-inch square or round cup-head pins. Insulation pins are to be welded to ducts.

6. Duct Support Systems: Provide one layer of insulation to cover support components. Maintain 3-inch overlap.

7. Application:

   a. Provide 2-hour enclosure on grease exhaust duct. Enclosure shall extend from kitchen hood to underside of roof deck.

D. INTERIOR EXPOSED DUCT

1. Duct shall be galvanized double wall insulated round or rectangular with perforated liner. Insulation shall be acrylic coated to prevent biological growth and airside erosion. Provide 1-1/2”, 1.5 pcf (installed R-Value of 6.0) on interior

exposed duct. Duct and fittings shall use a bolted flange with neoprene gasket at each connection. Provide factory seal at flange and duct. Visual sealant on exposed interior duct to be painted is unacceptable.

2. Round duct to be galvanized spiral lockseam type.

3. Exposed round duct shall utilize single rod hangers with angle support rings. Double rod hangers are only acceptable on concealed duct.

4. Application: Provide double wall duct as follows:

   a. Gymnasiums
   b. Natatoriums
   c. Return air plenums with ducted connection to return grilles
   d. Ducted connections to return air grilles
   e. Any area where ductwork is exposed

3.3 FIELD QUALITY CONTROL

A. Inspection: Upon completion of installation of the duct system and before operation is to commence, visually inspect the system and verify that it has been correctly installed.

B. Contractor shall inspect systems during test and balance to ensure that the formation of condensation is not present. Contractor shall be responsible for damage caused by condensation.

3.4 PROTECTION

A. Protect installed work from damage due to subsequent construction activity on the site.

3.5 INSULATION SCHEDULE

A. Supply and return ducts routed indoors (Ambient temperature $\leq$ 85 degrees Fahrenheit, RH $\leq$ 70 percent): R-8.3 (minimum).

B. Supply, return, and exhaust ducts routed in unconditioned spaces including but not limited to: un-conditioned plenums (non-return air plenums), attics, exterior soffits, mechanical/boiler rooms and crawl spaces. (Ambient temperature $\leq$ 95 degrees Fahrenheit, RH $\leq$ 70 percent): R-8.3 (minimum).

C. Supply, return and exhaust ducts routed outdoors or in spaces where temperature and relative humidity exceed that specified for unconditioned spaces: R-8.3 (minimum).

D. R-values represent installed values.

E. Provide multiple layers of insulation or thicker insulation to achieve R-values listed. If multiple layers are utilized, inner insulation layer shall not include vapor retarder.

END OF SECTION 23 07 13

SECTION 23 07 16 - HVAC EQUIPMENT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

A. Section Includes:

1. Chilled Water Components
2. Heating Hot Water Components

1.2 SYSTEM DESCRIPTION

A. Provide equipment insulation systems that have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.

B. Performance Requirements: Provide equipment insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:

1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.
2. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems.

1.3 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work

C. Submit manufacturer’s product data and installation instructions.

D. Provide drawings indicating typical duct insulation details, thickness, and location. Identify areas and required insulation.

E. Manufacturer’s certificate that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Utilize an installer who has demonstrated five (5) years experience on projects of similar size and complexity.

B. Condensation on any insulated system is not acceptable. Replace insulation damaged by condensation.

C. Insulation to provide minimum R-Value in accordance with International Energy Conservation Code with Houston Amendment.

D. Certifications: Manufacturer certification that products supplied meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.

B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Johns Manville
2. Owens-Corning
3. Knauf
4. Certainteed

B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Pittsburg Corning
2. Cell-U-Form

C. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:

1. Perma Glass Mesh
2. Alpha Glass Mesh
3. Childers Chil-Glas
4. Vimasco
5. RPR Products Inc.

D. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:

1. Childers
2. Foster
3. Vimasco

2.2 EQUIPMENT INSULATION

A. Glass Fiber Insulation Boards:

1. Thickness: Same thickness as connected piping.

2. Equipment Operating Temperature Limit (ASTM C411): Up to 450 degrees Fahrenheit.

3. Insulation Jacket Temperature Limit (ASTM C1136): -20 - 150 degrees Fahrenheit.

4. Vapor Retarder: ASJ vapor retarder facing.

5. Jacket Permeance (ASTM E96): 0.02 perm.

6. Jacket Puncture Resistance (ASTM D781): ASJ: 50 units.

7. Water Vapor Sorption (ASTM C1104): <2pecent by weight at 120 degrees Fahrenheit.

8. Density: Same as adjoining pipe insulation.

9. Composition Surface Burning Characteristics (UL 723, ASTM E84): Flamespread 25, smoke developed 50.

B. Equipment and Tank Insulation:

1. Description: Flexible pipe and tank insulation made of semi-rigid fibrous glass board material with a laminated Kraft-aluminum foil ASJ facing.

2. Operating Temperature (ASTM C411): 0 - 650 degrees Fahrenheit.

3. Length: 36 inches.

4. Size: 1-1/2 inches.

5. Material Standard: Comply with ASTM C1393, Type II.

6. Material Standard: Comply with ASTM C795.

7. Material Standard: Comply with ASTM C1136, Type II.

8. Material Standard: Comply with NRC Guide 1.36.

9. Jacket Temperature Limitation (ASTM C1136): -20 - 50 degrees Fahrenheit.

10. Jacket Permeance (ASTM E961): 0.02 perm.

11. Puncture Resistance (ASTM D781): 50 units.

12. Compressive Strength at 10 % Deformation (ASTM C165): 125 psf.

2.3 CELLULAR GLASS INSULATION

A. Rigid factory fabricated closed-cell equipment insulation:

1. Thermal conductivity "k" of btuh-in / hr-sq.ft. degree F at 75-degree mean temperature.

2. Density shall be an average of 8 lb./cu.ft.

3. Compressive strength of 100 psi.

2.4 ALUMINUM JACKET

A. Jacket for equipment and tanks shall be 0.16-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.

B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering. Fitting covers shall be manufactured to ASTM C-450 standards.

PART 3 - EXECUTION

3.1 GENERAL

A. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Do not apply insulation to equipment, breeching, or stacks while hot.

E. Apply insulation using staggered joint method for both single- and double-layer construction, where feasible. Apply each layer of insulation separately.

F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least two (2) inches. Apply over vapor barrier where applicable.

H. Do not insulate boiler manholes, hand holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

J. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by manufacturer.

3.2 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions and recommendations of the equipment insulation manufacturer.

3.3 EXAMINATION

A. Site Verification of Conditions:

B. Verify that site conditions are acceptable for installation of equipment insulation.

C. Do not proceed with installation of equipment insulation until unacceptable conditions are corrected.

3.4 INDOOR CHILLED WATER PUMPS

A. Shall be insulated with rigid insulation board, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide x .020 galvanized bands spaced on nine (9) inch centers. Bands shall be pulled snug over sheets of insulation board. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. All voids on the interior of box shall be filled with glass fiber blanket insulation. Exterior shall be finished with a trowel coat of vapor barrier mastic, a layer of one (1) inch mesh galvanized wire, and a coat of cement. Final finish shall be an eight-ounce canvas jacket, pasted and sealed in place.

B. Pipe insulation shall be extended over all cold parts of chilled water pumps not directly over drainage basin of pump base.

3.5 OUTDOOR CHILLED WATER PUMPS

A. Shall be insulated with cellular glass insulation, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide aluminum bands spaced on nine (9) inch centers. Bands shall be pulled snug over insulation. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. Provide aluminum jacket over insulation.

3.6 ALUMINUM JACKET

A. Install insulating materials per manufacturer’s recommendations.

B. Install aluminum jacketing per manufacturer’s recommendations.

C. Apply aluminum jacketing by lapping, sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.

D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.

E. Lap joints against weather so that water will run off lower edge.

F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.

G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.

H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.

I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.

J. Equipment exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.

3.7 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATED WITH FIBERGLASS

A. Location: Indoor, conditioned spaces

B. Support Inserts: At each support point, install a hard section of cellular glass on lower 180 degrees of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Seal and finish to match the adjoining insulation. Provide formed 16 ga. galvanized sheet-metal saddles.

C. Installation: All equipment must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide three (3) inch butt strips at each joint between sections and seal with adhesive.

3.8 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATE WITH CELLULAR GLASS

A. Location: Outdoor, un-conditioned spaces and ventilated spaces

B. The insulation shall be applied to equipment with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.

C. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.

D. Metal jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.

E. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.

3.9 INSULATION SCHEDULE

A. Chilled water components located within condition spaces.

1. Insulation thickness: Match adjoining piping thickness.

B. Chilled water components located in un-conditioned or ventilated spaces and outdoors

1. Insulation thickness: Match adjoining piping thickness.

3.10 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 07 16

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Pipe Insulation

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.

B. Performance Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:

1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.

C. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

b. Detail attachment and covering of heat tracing inside insulation.

c. Detail insulation application at pipe expansion joints for each type of insulation.

d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

e. Detail removable insulation at piping specialties.

f. Detail application of field-applied jackets.

g. Detail application at linkages of control devices.

1.5 QUALITY ASSURANCE

A. Installation Qualifications: Utilize an installer having demonstrated (5) five years experience on projects of similar size and complexity.

B. Condensation on any insulated piping system is not acceptable. Replace insulation damaged by condensation at no additional cost.

C. All materials shall conform to Composite Surface Burning Characteristics (UL 723, ASTM E84):

1. Flamespread: 25

2. Smoke developed: 50

D. All materials shall have U.L. label.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver insulation materials in manufacturer’s original, unopened, undamaged containers with identification labels intact

B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Johns Manville
2. Owens Corning
3. Knauf

4. Certainteed

B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Pittsburg Corning
2. Cell-U-Foam

C. Phenolic Foam Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Resolco
2. Koolphen® K

D. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:

1. Childers
2. Pabco
3. RPR

E. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:

1. Perma Glass Mesh
2. Alpha Glass Mesh
3. Childers Chil-Glas
4. Vimasco

F. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:

1. Childers
2. Foster
3. Vimasco

2.2 FIBERGLASS PIPE INSULATION

A. High density factory molded fiberglass insulation with factory applied all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.

1. Thermal conductivity “k” of 0.23 of Btu-in / hr-sq.ft. °F at 75-degree mean temperature.
2. Maximum jacket permeance shall be 0.02.

2.3 CELLULAR GLASS INSULATION

A. Rigid factory fabricated closed-cell pipe insulation:

1. Thermal conductivity “k” of 0.32 Btuh-in / hr-sq.ft. °F at 75-degree mean temperature.
2. Density shall be an average of 8 lb/cu.ft.
3. Maximum jacket permeance shall be 0.02.
4. Compressive strength of 100 psi.

2.4 PHENOLIC FOAM INSULATION

A. Rigid factory molded phenolic foam insulation with factory applied, all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.

1. Thermal conductivity “k” of 0.18 btu-in / hr-sq.ft. °F at 75°-degree mean temperature.
2. Maximum jacket permeance shall be 0.02.
3. Compressive strength of 24 psi

2.5 ALUMINUM JACKET

A. Jacket for piping shall be 0.016-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.

B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering.

PART 3 -EXECUTION

3.1 SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer’s recommendations.

3.2 PREPARATION

A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.

B. Ensure that insulation is clean, dry and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

A. Install all insulation materials and accessories in accordance with manufacturer’s published instructions and recognized industry practices to ensure that it will serve its intended purpose.

B. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

D. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.

E. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

F. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

G. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

H. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

I. Apply multiple layers of insulation with longitudinal and end seams staggered.

J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

K. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

L. Keep insulation materials dry during application and finishing.

M. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

N. Apply insulation with the least number of joints practical.

O. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

P. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

Q. Apply insulation continuously through hangers and around anchor attachments.

R. For insulation application where vapor retarder is indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

S. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

T. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

U. Insulation Terminations: For insulation application where vapor retarder is indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

V. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

W. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.

3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

   a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder

4. Vapor-Retarder Mastics: Where vapor retarder is indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings, at penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

5. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

   a. Seal penetrations with vapor-retarder mastic

   b. Apply insulation for exterior applications tightly joined to interior insulation ends.

   c. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.

   d. Seal metal jacket to roof flashing with vapor-retarder mastic.

6. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

7. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

8. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

   a. Fire stopping and fire-resistive joint sealers are specified in Division 7.

9. Floor Penetrations: Apply insulation continuously through floor assembly.

   a. For insulation with vapor retarder, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

X. Insulation Installation of Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.

2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.

3. For insulation with factory-applied jackets without integral vapor retarder, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

Y. Insulation Installation on Pipe Flanges:

1. Apply preformed cellular-glass pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cellular-glass block insulation.

4. Install jacket material with manufacturers recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

Z. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of molded cellular-glass insulation and match thickness to that of adjoining pipe. Fittings and fabricated segments shall be securely held in place with ½ inch x 0.20-inch type 3105 aluminum bands.

    a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.

    b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.

    c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.

AA. Insulation Installation on Valves:

1. Install preformed two-piece factory molded cellular-glass insulation to valve body, match adjoining pipe insulation thickness. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. Install insulation to flanges as specified for flange insulation application.

    a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.

    b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.

c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.

BB. PVC Cover:

1. Provide factory molded covers for all fittings, elbows and flanges.

3.4 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

a. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.

b. Embed 10 x 10 fiberglass cloth between two 0.062-inch-thick coats of jacket manufacturer's recommended adhesive.

c. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. Apply foil and paper jackets where indicated.

a. Draw jacket material smooth and tight.

b. Apply lap or joint strips with the same material as jacket.

c. Secure jacket to insulation with manufacturer's recommended adhesive.

d. Apply jackets with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints. Where vapor retarder is indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder mastic to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.

e. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

3.5 CHILLED WATER, HOT WATER, CONDENSATE DRAIN AND MISCELLANEOUS PIPING SYSTEMS

A. Location: Indoor, conditioned spaces - return air plenums, air handling unit rooms

B. Insulation Type:
1. Heating Water and Condensate Piping: **Fiberglass**

2. Chilled Water Piping: **Phenolic Foam**

C. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining insulation. Cellular glass length shall overhang a minimum of 2” on both sides of the saddle. Refer to 3.5, E for saddle length requirements.

D. Provide formed 16 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside

hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends with aluminum banding with a thickness of 0.20, ¾" width and joined with ¾" aluminum wing seals.

E. Provide formed 16 ga. galvanized sheet-metal saddles as follows:

3. Insert and saddle lengths:

a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
b. 3 inch through 6-inch pipe - 12 inches Long
c. 8 inch through 10-inch pipe - 16 inch Long
d. 12 inches and larger pipe - 22 inches Long

F. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide 3-inch butt strips at each joint between sections and seal with adhesive.

G. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

3.6 CHILLED WATER, HOT WATER, CONDENSATION DRAIN AND MISCELLANEOUS PIPING SYSTEMS

A. Location: Outdoor, un-conditioned spaces (non-return air plenums) and ventilated spaces. Shall include but not limited to: boiler rooms, non-return air plenum mechanical rooms, chiller rooms, and pump rooms.

B. Insulation Type:

1. Condensate Piping: **Fiberglass**

2. Chilled Water and Heating Water Piping: **Phenolic Foam**

C. Cellular Glass Installation:

1. The insulation shall be applied to piping with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.

2. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.

3. Aluminum jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.
4. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.

D. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining insulation.

E. Provide formed 14 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends

with aluminum banding with a thickness of 0.20, ¾" width and joined with ¾" aluminum wing seals.

F. Provide formed 14 ga. galvanized sheet-metal saddles as follows:

1. Insert and saddle lengths:

a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
b. 3 inch through 6-inch pipe - 12 inches Long
c. 8 inch through 10-inch pipe - 16 inch Long
d. 12 inches and larger pipe - 22 inches Long

G. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive and vapor retarder mastic. Provide 3-inch butt strips at each joint between sections and seal with adhesive.

H. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

3.7 ALUMINUM JACKET

A. Install insulating materials per manufacturer's recommendations.

B. Install aluminum jacketing per manufacturer's recommendations.

C. Apply aluminum jacketing by lapping and sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.

D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.

E. Lap joints against weather so that water will run off lower edge.

F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.

G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.

H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.

I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.

J. Pipe exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.

K. All exterior pipes shall have specified aluminum jacket for protection.

3.8 PROTECTION

A. Replace damaged aluminum jacketing and insulation, including insulation with vapor barrier damage and moisture-saturated insulation.

B. The insulation contractor shall advise the general and / or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.9 INSULATION SCHEDULE

A. Chilled water piping located within condition spaces.

1. Insulation thickness **(Phenolic Foam)**:

a. 1-1/2” thick insulation for: ½” through 2” pipe
b. 2” thick insulation for: 2-1/2” and larger pipe

B. Chilled water and hot water piping located in un-conditioned or un-ventilated spaces and outdoors.

1. Insulation thickness **(Phenolic Foam)**:

a. 1-1/2” thick insulation for: ½” through 2” pipe
b. 2” thick insulation for: 2-1/2” and larger pipe

C. Hot water piping located within conditioned spaces

1. Insulation thickness: **(Fiberglass):**

a. 1-1/2” thick insulation for: ½” through 1-1/2” pipe
b. 2” thick insulation for: 2” and larger pipe

D. Cold Condensate Drain Lines

1. Insulation thickness: **(Fiberglass):**

a. 1” thick insulation for all pipe sizes and locations

END OF SECTION 23 07 19

SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Section 019114 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Section 012100 "Allowances."

1.6 UNIT PRICES

A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Section 012200 "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.7 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.8 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.9 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.

2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.

3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.

4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.

5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.

6. Test and inspection reports and certificates.

7. Corrective action documents.

8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least [10] days in advance of testing and balancing Work and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.

2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.

4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Subcontractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R **Subcontractor** shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test

section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

2. Description of equipment for flushing operations.

3. Minimum flushing water velocity.

4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of hot-water and solar systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

H. Refer to plans and specifications for HVAC system type.

END OF SECTION 23 08 00

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 09 23 - DIRECT DIGITAL CONTROLS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Heating and cooling piping:

1. Control valves
2. Flow meters
3. Flow switches
4. Press and temp sensor wells & sockets
5. Temp sensor wells and sockets

B. Duct accessories:

1. Airflow stations
2. BAS control dampers
3. Terminal unit controls

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

A. Communications with Third Party Equipment:

1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet interface for integration into the Direct Digital Control System described in this section (reference sequence of operations and points list for specifics). Those systems include:

a. Boilers
b. Chillers
c. Cooling Towers
d. Switchgear
e. Variable Speed Drives
f. Computer Room Units (MDF)
g. Rooftop Units

EQUIPMENT SHALL BID AS AN ALTERNATE

1.4 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

B. The following sections constitute related work:

1. Division 01- General

2. Division 23 – Mechanical

3. Division 26 – Electrical

1.5 DESCRIPTION

A. General: The control system shall consist of a complete BAS system with a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphics. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface. If individual software seat licenses or keys are required provide a minimum of 4 additional licenses to accommodate multiple owner operators.

B. If manufacture offers a web-based BAS platform, the installing contractor shall provide the new web-based software and software updates required for this project. Additionally, the installing contractor shall provide all computer related components (BAS web server – reference specifications for hardware requirements) for the new software platform to function in a peer-to-peer environment.

C. The system shall directly control HVAC equipment as specified in Sequences of Operation. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints.

D. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, setpoints, trends, and alarms specified shall be BACnet objects.

1.6 APPROVED CONTROL SYSTEMS

A. The following are approved control system suppliers, manufacturers, and product lines:

1. Reliable Controls – Installed by Unify Energy Solutions

2. Trane - Tracer

1.7 QUALITY ASSURANCE

A. Installer and Manufacturer Qualifications

EQUIPMENT SHALL BID AS AN ALTERNATE

1. Installer shall have an established working relationship with Control System Manufacturer for a period of 10 years or greater. If the distributorship has not had duration of more than 10 years, the contractor will not be approved without the written approval prior to bid date (no exceptions).
2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

3. BAS Graphics shall be Three Dimensional Thermographic.

4. BAS provider shall warranty controllers for 1 years.

5. BAS Provider shall provide lifetime training for the lifecycle of the facility to the owner at no additional cost.

1.8 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authority's codes and ordinances for these plans and specifications. At a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:

1. National Electric Code (NEC)

2. International Energy Conservation Code (IECC)

3. International Building Code (IBC)

4. Uniform Mechanical Code (UMC)

5. ASHRAE Standard 135-2016: BACnet - A Data Communication Protocol for Building Automation and Control Networks

1.9 SYSTEM PERFORMANCE

A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).

1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 seconds.

2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 seconds and shall automatically refresh every 15 seconds.

3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 seconds.

4. Object Command. Devices shall react to command of a binary object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.

EQUIPMENT SHALL BID AS AN ALTERNATE

5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 seconds.

6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with the mechanical process under control.

7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.

8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 seconds of other workstations.

9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.

10. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control. Control signal should be 0-10 vdc.

Control Stability and Accuracy. Control loops shall maintain measured variable at set point within tolerances listed in Table 2.

Table1
Reporting Accuracy

Measured Variable	**Reported Accuracy**
Space Temperature	±2ºF
Ducted Air	±2ºF
Outside Air	±2ºF
Dew Point	±3ºF
Water Temperature	±2ºF
Delta-T	±0.25ºF
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±0.1 in. w.g.
Air Pressure (space)	±0.01 in. w.g.
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO_2)	±50 ppm

Note 1: 10% - 100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters

Table 2

EQUIPMENT SHALL BID AS AN ALTERNATE

Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±0.2 in. w.g. ±0.01 in. w.g.	0-6 in. w.g. -0.1 to 0.1 in. w.g.
Airflow	±10% of full scale	
Space Temperature	±2.0ºF	
Duct Temperature	±3ºF	
Humidity	±5% RH	
Fluid Pressure	±1.5 psi ±1.0 in. w.g.	1-150 psi 0-50 in. w.g. differential

1.10 SUBMITTALS

A. Product Requirements: Provide one electronic copy and 4 hard copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. If requested, provide drawings as AutoCAD 2017 and 4 prints of each drawing on 8.5 x 11 paper and 1 electronic copy of each drawing. When manufacturer's cut sheets apply to a product series rather than a specific product, **clearly indicate applicable data by highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals on the following:

1. Direct Digital Control System Hardware

   a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.

   b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:

      1. Direct digital controllers (controller panels)

      2. Transducers and transmitters

      3. Sensors (include accuracy data)

      4. Actuators

      5. Valves

      6. Dampers

      7. Relays and switches

      8. Control panels

      9. Power supplies

10. Batteries

11. Operator interface equipment

12. Wiring

c. Wiring diagrams and layouts for each control panel. Show termination numbers.

d. Floor plan schematic diagrams indicating field sensor and controller locations.

e. Riser diagrams showing control network layout, communication protocol, and wire types.

2. Central System Hardware and Software

a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.

b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:

1. Central Processing Unit (CPU) or web server

2. Monitors

3. Keyboards

4. Power supplies

5. Battery backups

6. Interface equipment between CPU or server and control panels

7. Operating System software

8. Operator interface software

9. Color graphic software

10. Third-party software

c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.

d. Network riser diagrams of wiring between central control unit and control panels.

3. Controlled Systems

a. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.

b. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.

c. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.

d. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified. Indicate alarmed and trended points.

4. Description of process, report formats, and checklists to be used in Section 23 09 23 Article 3.15 (Control System Demonstration and Acceptance).

B. Schedules

1. Within two months of contract award, provide schedule of work indicating:

a. Intended sequence of work items

b. Start date of each work item

c. Duration of each work item

d. Planned delivery dates for ordered material and equipment and expected lead times

e. Milestones indicating possible restraints on work by other trades or situations

2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

C. Project Record Documents. Submit 8 copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:

1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2017 and 6 prints of each drawing on 8 ½” x 11" paper.

2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of (Control System Demonstration and Acceptance).

3. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:

a. As-built versions of submittal product data.

b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.

c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.

d. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.

e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.

f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.

g. Graphic files, programs, and database on magnetic or optical media.

h. List of recommended spare parts with part numbers and suppliers.

i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.

j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.

k. Licenses, guarantees, and warranty documents for equipment and systems.

l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

D. Training Materials: The contractor shall provide training to owner personnel in a laboratory classroom environment. Each student shall be provided with a dedicated computer workstation utilizing a simulated BAS software platform that is installed for this project. The instructors shall have CEU accreditation for all training courses offered. Provide documentation for this requirement in the initial BAS submittal. If contractor does not have CEU instructor or offer these courses locally include cost for tuition, travel and boarding to send students to manufacturer training facility. The owner shall receive free training for the life of the system.

1. Operator Overview – Consists of general system navigation, scheduling functions, setpoint modifications and parameter adjustments.

2. Advanced Topics Overview – Detailed analysis of trend setup/configuration, trend historian, alarm setup, alarm actions (email, printing, etc.), point renaming, and detailed analysis of equipment parameters.

3. Program/Logic Manipulation – Modify system programs as needed for additions and modifications.

4. Graphic Manipulation – Modify system graphics as needed for additions and modifications.

5. Hardware Troubleshooting – Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common problems regularly encountered.

6. Software Troubleshooting - Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common issues that can be utilized via software modifications.

7. Central Plant Operation – At a minimum the instructor shall thoroughly explain different types of central plant equipment and proper system modifications that can be made to enhance system performance and energy savings.

8. HVAC System Training – Objective of this class is to provide basic HVAC system knowledge of various types of systems including types of air side distribution and water side distribution. Topics such as thermodynamics, psychometrics, de-humidification, and demand control ventilation shall be thoroughly explained.

1.11 WARRANTY

A. Warrant work as follows:

1. Warrant materials for specified control system and peripheral control devices free from defects for a period of **1 years** after certificate of substantial completion. Warrant all labor for a period of **1 year** after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request. Additionally, contractor shall offer 24/7 after-hours support to include alarm monitoring and associated dispatch service.

2. Provide graphic modifications for a period of 3 years from date of substantial completion. This shall include room number and equipment modifications as requested by the owner.

3. Provide telephone support free to the owner for a period of 3 years after substantial completion. This service includes technical support for all BAS equipment and shall include troubleshooting and problem resolution via the telephone or web services. Service shall be available during the hours of 7am to 5pm Monday – Friday.

4. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.

5. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor or Owner identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.

6. Exception: Contractor shall not be required to warranty existing devices except those that have been rebuilt or repaired during installation.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:

1. Graphics

2. Record drawings

3. Database

4. Application programming code

5. Documentation

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ASHRAE/ANSI Standard 135-2016, BACnet.

B. Use existing Ethernet backbone for network segments marked "existing" on project drawings.

C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.

1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.

2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Sequence of Operations. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.

F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

G. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable the system to both read and write data.

1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.

2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.

3. For read or write requests, the system shall require username and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.

2.3 OPERATOR INTERFACE

A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. Existing manufacturer's BAS web server and workstation can be utilized. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA). This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:

1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.

EQUIPMENT SHALL BID AS AN ALTERNATE

2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.

3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.

4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.

B. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ASHRAE/ANSI 135-2016, BACnet Annex J.

C. Hardware. If providing a new server, each workstation or web server shall consist of the following:

1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Section 23 09 23 Paragraph 1.8. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Sequences of Operation, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server shall be Compaq Rack Mounted Server (or equal) with a minimum of:

   a. Dual Processor Intel Pentium 3.66 GHz processor

   b. 1 GB RAM

   c. 80 GB hard disk providing data at 100 MB/sec

   d. RAID 5 Configuration

   e. 128x CD-ROM drive

   f. Most Current Windows Server Operating System

   g. Serial, parallel, and network communication ports and cables required for proper system operation.

2. If providing a server, the server shall support one or more the following database types:

   a. SQL Server 2012 R2
   b. PostgreSQL
   c. MySQL

d. MS Access

D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:

1. Log In and Log Out. System shall require username and password to log in to operator interface.

2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.

3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.

4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.

5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.

6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.

7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.

8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.

9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

E. System Software.

1. Operating System: Web server or workstation shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows XP Pro, Red Hat Linux, or Sun Solaris.

2. System Graphics: Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on

each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint. Graphics shall

a. Functionality: Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.

b. Animation: Graphics shall be able to animate by displaying different image files for changed object status.

c. Alarm Indication: Indicate areas or equipment in an alarm condition using color or other visual indicator.

d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).

F. System Tools. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.

1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.

2. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.

3. System Configuration. Operators shall be able to configure the system.

4. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.

5. Security. System shall require a username and password to view, edit, add, or delete data.

a. Operator Access. Each username and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object. Authorized operators shall be able to vary and deny each operator's accessible functions based on equipment or geographic location.

b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.

c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.

6. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).

7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93.Alarms shall be BACnet alarm objects and shall use BACnet alarm services.

8. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.

9. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.

10. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.

11. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. The contractor shall configure all physical control points and software control points to accumulate trend data. Analog values shall be configured utilizing time-based intervals and digital values shall be configured for COV. Provide at a minimum of 250 samples per control point. If data can be stored locally at the controller level, this information shall be archived at the central server or all BAS workstations.

12. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.

13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.

14. Standard Reports. Furnish the following standard system reports:

a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.

b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.

c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:

1. Alarm History.

2. Trend Data. Operator shall be able to select trends to be logged.

3. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.

15. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.

16. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.

17. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.

18. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
    a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."

    b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.

    c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.

d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.

e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.

f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.

g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.

1. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.

2. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

19. BACnet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.

2.4 CONTROLLER SOFTWARE

A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.

B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.14.c.3 (Operator Activity).

C. Scheduling. See Paragraph 2.3.D.4 (View and Adjust Operating Schedules). System shall provide the following schedule options as a minimum:

1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).

2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall

discard and replace exception schedule with standard schedule for that day of the week.

3. Holiday. Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.

D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.

E. Binary and Analog Alarms. See Paragraph 2.3.F.7 (Alarm Processing).

F. Alarm Reporting. See Paragraph 2.3.F.9 (Alarm Reactions).

G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.

H. Maintenance Management. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 23 09 93.

I. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 09 93.

J. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.

K. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.

L. Energy Calculations.

1. System shall accumulate and convert instantaneous power (kW) or flow rates (gpm) to energy usage data.

2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

3. System shall calculate a fixed-window average. Window interval start shall be defined by utility meter digital input signal to synchronize system's and utility's fixed-window averages.

M. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

N. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.

O. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on

exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified.

2.5 CONTROLLERS

A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), and Smart Actuators (SA) as required to achieve performance specified in Section 23 09 23 Article 1.8 (System Performance).

B. BACnet.

1. Building Controllers (BCs). Each BC shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Building Controller (B-BC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.

2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.

3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.

4. Smart Actuators (SAs). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.

5. BACnet Communication.

a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.

b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.

c. Each AAC and ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

d. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

C. Communication.

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.

2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.

3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.

4. Stand-Alone Operation. Each piece of equipment specified in Sequences of Operation shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.

1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -20°F to 140°F.

2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 32°F to 120°F.

E. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

F. Serviceability.

1. Controllers shall have diagnostic LEDs for power, communication, and processor.

2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.

3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

G. Memory.

1. Controller memory shall support operating system, database, and programming requirements.

2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.

3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

H. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).

EQUIPMENT SHALL BID AS AN ALTERNATE

I. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.

C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.

E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

F. Binary Outputs. Binary outputs shall send a pulsed low-voltage signal for pulse width modulation control or an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.

H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

I. Pulse-Width Modulation. Control actuators designed for pulse-width modulation with a single binary output that cycle with variable on and off times as determined by the application software. Pulse-width modulation may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

J. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.7 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

EQUIPMENT SHALL BID AS AN ALTERNATE

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.

    a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.

    b. Line voltage units shall be UL recognized and CSA listed.

B. Power Line Filtering.

1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:

    a. Dielectric strength of 1000 V minimum

    b. Response time of 10 nanoseconds or less

    c. Transverse mode noise attenuation of 65 dB or greater

    d. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 AUXILIARY CONTROL DEVICES

A. Motorized Control Dampers.

1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.

    a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.

    b. Other modulating dampers shall be opposed-blade.

    c. Two-position shutoff dampers shall be parallel or opposed-blade with blade and side seals.

2. Frame. Damper frames shall 16-gauge galvanized steel channel or 1/8 in. extruded aluminum with reinforced corner bracing.

3. Blades. Damper blades shall not exceed 8 inches in width or 48 inches in length. Blades shall be suitable for medium velocity (2000 fpm) performance. Blades shall be not less than 16 gauge.

4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.

5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade

seals shall leak no more than (10 cfm per ft ^{2}) at (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of (1500 fpm).

6. Sections. Damper sections shall not exceed 48 in. - 60 in. Each section shall have at least one damper actuator.

7. Linkages. Dampers shall have exposed linkages.

B. Electric Damper and Valve Actuators.

1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.

2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).

3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range.

4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.

5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 60 inch -.lb torque capacity shall have a manual crank.

6. Acceptable Manufacturers:

a. Belimo

C. Control Valves.

1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.

2. Type. Provide two or three-way control valves for two-position or modulating service as shown.

3. Water Valves.

a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.

b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.

1. Two-way: 100% of total system (pump) head.

2. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

c. Ports. Valves providing modulating service shall have equal percentage ports.

d. Sizing.

1. Two-position service: line size.

2. Two-way modulating service: select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi).

3. Three-way modulating service: select pressure drop equal to the smaller of twice the pressure drop through the coil exchanger (load) or 35 kPa (5 psi).

4. Two-way and three-way modulating valve shall be one or two sizes smaller than the pipe size.

e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.

1. Water zone valves: normally closed.

2. Heating coils in air handlers: normally closed.

3. Chilled water control valves: normally open.

4. Other applications: as scheduled or as required by sequences of operation.

f. Acceptable Valve and Actuator Manufacturers:

1. Belimo

D. Binary Temperature Devices.

1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.

2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.

3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 20 ft long. Element shall sense temperature in each 1 ft section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

E. Temperature Sensors.

1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.

2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 ft in length per 10 ft ^{2} of duct cross-section.

3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.

4. Space Sensors: Space sensors shall be stainless steel flush plate mounted type.

5. Differential Sensors. Provide matched sensors for differential temperature measurement.

F. Humidity Sensors.

1. Duct and room sensors shall have a sensing range of 20%-80%.

2. Duct sensors shall have a sampling chamber.

3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°F-170°F.

4. Humidity sensors shall not drift more than 1% of full scale annually.

G. Flow Switches. Flow-proving switches shall be thermal dispersion type (IFM U 40100 or approved equal) or differential pressure type (air or water service). Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).

1. Thermal dispersion type switches shall have relay output, wire break output and temperature output.

2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 4 enclosure unless otherwise specified.

H. Relays.

1. Control Relays. Control relays shall be plug-in type, UL listed and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

I. Override Timers.

1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

EQUIPMENT SHALL BID AS AN ALTERNATE

J. Current Transmitters.

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be ±1% full-scale at 500-ohm maximum burden.

2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.

3. Unit shall be split-core type for clamp-on installation on existing wiring.

K. Current Transformers.

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.

2. Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full-scale output.

3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

L. Voltage Transmitters.

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.

2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be ±1% full-scale at 500-ohm maximum burden.

3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

M. Voltage Transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.

2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.

3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

N. Power Monitors.

1. Power monitors shall be three-phase type and shall have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.

2. Power monitors shall provide selectable output: rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with 5 A current inputs and maximum error of ±2% at 1.0 power factor or ±2.5% at 0.5 power factor.

O. Current Switches.

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

P. Pressure Transducers.

1. Transducers shall have linear output signal and field-adjustable zero and span.

2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.

3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.

4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.

Q. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

R. Pressure-Electric (PE) Switches. PE switches shall be UL listed, pilot duty rated (125 VA minimum) or motor control rated, metal or neoprene diaphragm actuated, operating pressure rated for 0-175 kPa (0-25 psig), with calibrated scale minimum setpoint range of 14-125 kPa (2-18 psig).

1. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application.

2. Switches shall be open type (panel-mounted). Exception: Switches shall be enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.

3. Each pneumatic signal line to PE switches shall have permanent indicating gauge.

S. Local Control Panels.

1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.

2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection

terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.

3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

2.9 WIRING AND RACEWAYS

A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.

B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.

B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.

C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 23 09 23 work with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.

B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

A. Site.

1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.

2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Submittals. See Section 23 09 23 Article 1.9 (Submittals).

C. Test and Balance.

1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.

2. Train Test and Balance Contractor to use control system interface tools.

3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.

4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.

D. Life Safety.

1. Duct smoke detectors required for air handler shutdown are provided and wired under Division 26.

2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23 and wired by Division 26.

3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 26.

E. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.

1. Communication media and equipment shall be provided as specified in Section 23 09 23 Article 2.2 (Communication).

2. Each supplier of a control's product shall configure, program, start up, and test that product to meet the sequences of operation described regardless of where within the contract documents those products are described.

3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.

4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.

B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.

C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.

EQUIPMENT SHALL BID AS AN ALTERNATE

D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.

E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.5 FIELD QUALITY CONTROL

A. Commissioning and start-up of the BAS system shall be performed factory certified employees of the BAS contractor or manufacturer. Under no instances shall electrical subcontractors perform this work.

B. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Article 1.7 (Codes and Standards).

C. Continually monitor field installation for code compliance and workmanship quality.

D. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.6 WIRING

A. To differentiate BAS wiring from that of other trades, all cable except for underground will have a **yellow outer jacket** (no exceptions).

B. Division 26 contractor shall supply a dedicated 120vac power to a junction box in each mechanical room for use by the BMCS.

C. A Conduit fill based on plenum 18-gauge 2 conductor:

1. 1/2 inch - No more than 4 conductors.

2. 3/4 inch - No more than 8 conductors.

3. 1 inch - No more than 12 conductors.

D. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 23 09 23 differ from Division 26, Section 23 09 23 shall take precedence.

E. All wires whether control network or device wire shall be marked with Brady-type markers.

F. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.

G. Low-voltage wiring shall meet NEC Class 2 requirements. Sub-fuse low-voltage power circuits as required to meet Class 2 current limit.

H. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.

I. Install wiring in raceway where subject to mechanical damage and at levels below 10ft. in mechanical, electrical, or service rooms.

EQUIPMENT SHALL BID AS AN ALTERNATE

J. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

K. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.

L. Do not install wiring in raceway containing tubing.

M. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at (5 ft) intervals.

N. Contractor shall install all low voltage communication wiring as per all TIA/EIA communication cabling standards. All cabling shall be installed in dedicated cabling support such as j-hook, d-rings, or saddles. All supports shall be supported directly from building structure. Do not support cabling or supports from ceiling grid wire, conduit, ductwork, piping, or other system cabling. All cabling must be installed in independent support for that given system and may not share supports or run-in same conduit or support. All cabling shall be supported every 5’-0” from approved cabling support method. Contractor shall bundle all system cabling and label all wiring for system they serve. All cabling passing thru walls shall require dedicated conduit sleeves with bushing to protect cabling during installation. Contractor shall provide 1 meter service loops at all device termination locations and 3-meter service loops at all head end termination locations. All low voltage HVAC control cabling shall be yellow in color unless specified otherwise. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.

O. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.

P. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.

Q. Include one pull string in each raceway 2.5 cm (1 in.) or larger.

R. Use color-coded conductors throughout.

S. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.

T. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.

U. Adhere to requirements in Division 26 where raceway crosses building expansion joints.

V. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.

W. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.

X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft.) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size.

Y. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.7 COMMUNICATION WIRING

A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).

B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.

C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.

D. Verify entire network's integrity following cable installation using appropriate tests for each cable.

E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.

F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.

G. Label communication wiring to indicate origination and destination.

H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.8 FIBER OPTIC CABLE

A. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.

B. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

3.9 INSTALLATION OF SENSORS

A. Install sensors according to manufacturer's recommendations.

B. Mount sensors rigidly and adequately for operating environment.

C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.

EQUIPMENT SHALL BID AS AN ALTERNATE

D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.

E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.

F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each 1 ft. ^{2} of coil area.

G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.

H. Install outdoor air temperature sensors on north wall at designated location with sun shield.

I. Differential Air Static Pressure.

1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.

2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.

3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.

4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.

5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.

6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.

J. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.10 FLOW SWITCH INSTALLATION

A. Adjust flow switch according to manufacturer's instructions.

3.11 ACTUATORS

A. General. Mount actuators and adapters according to manufacturer's recommendations.

EQUIPMENT SHALL BID AS AN ALTERNATE

B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.

1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.

2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten linkage.
3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

4. Provide necessary mounting hardware and linkages for actuator installation.

3.12 IDENTIFICATION OF HARDWARE AND WIRING

A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.

B. Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.

C. Permanently label or code each point of field terminal strips to show instrument or item served.

D. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.

E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.

F. Label valves with nameplates.

G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.

H. Label identifiers shall match record documents.

3.13 PROGRAMMING

A. Point Naming. Name points as shown on the equipment points list provided with each Sequence of Operation. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.

B. All DDC programming shall be accomplished through graphical programming, line code is unacceptable

C. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented.

EQUIPMENT SHALL BID AS AN ALTERNATE

1. Application Programming. Provide application programming that adheres to sequences of operation specified in Section 23 09 93. Program documentation or comment statements shall reflect language used in sequences of operation.

2. System Programming. Provide system programming necessary for system operation.

D. Operator Interface.

1. Standard Graphics. Provide graphics as specified in Section 23 09 23 Article 2.3 Paragraph E.2 (System Graphics). Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable Points List located in the Sequence of Operation. Point information on graphics shall dynamically update.
2. Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in Section 23 09 23.

3. DDC screen graphic room numbers shall be based on final room graphics package. Obtain Architect/Owner approval of final room numbers prior to programming.

3.14 CONTROL SYSTEM CHECKOUT AND TESTING

A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.

1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 23 09 23.

2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.

3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.

4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.

5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.

6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.

7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.

8. Alarms and Interlocks.

   a. Check each alarm with an appropriate signal at a value that will trip the alarm.

   b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.

   c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.15 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 3.15 (Control System Checkout and Testing). Provide Engineer with log documenting completion of startup tests.

1. Preliminary Review: At least 7 days prior to on-site demonstration, provide read-only username and password to Engineer for preliminary system review to be performed remotely. Engineer will review to verify all systems are connected and communicating and all points are reading properly, and graphics are complete. The Engineer will provide a report of any deficiencies. The contractor shall correct all deficiencies prior to on-site demonstration.

2. On-site Demonstration: Engineer, Owner, contractor(s) and any/all factory authorized equipment representatives shall be present to perform, observe and review system demonstration. Notify Engineer/Architect at least 10 days before system demonstration is scheduled.

   a. Demonstration shall follow process submitted and approved under Section 23 09 23 Article 1.9 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.

   b. Demonstrate actual field operation of each sequence of operation as specified in Section 23 09 93. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.

   c. Demonstrate compliance with sequences of operation through each operational mode.

   d. Demonstrate complete operation of operator interface.

   e. Demonstrate each of the following.

   f. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled

variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.

g. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.

h. Building fire alarm system interface.

i. Trend logs for each system. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section 23 09 93. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section 23 09 23 Article 2.3 Paragraph F.11 (Trend Configuration).

3. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

B. Acceptance.

1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.

2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section 23 09 23 Article 1.9 (Submittals).

3.16 CLEANING

A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.

B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.

C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

END OF SECTION 23 09 23

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 09 93 - SEQUENCES OF OPERATION FOR HVAC CONTROLS

GENERAL:

The BAS contractor shall provide all points listed under “Equipment Control Points” as well as any points required to accomplish the sequences of operation listed below. BAS Contractor shall provide new thermographics and programming for each system (new and existing equipment) to accurately reflect configuration and operation. At the 11 month walk-thru, BAS contractor shall provide a DDC demonstration and re-verification of point-to-point control of all equipment points and sequences with Owner and Engineer; no exceptions. BAS contractor must perform site visits of each and every building prior to bid date and thoroughly investigate all existing HVAC equipment pertaining to infrastructure upgrade. BAS contractor shall take inventory of existing equipment in order to determine what is to be removed, replaced, or upgraded. Failure to do so will be at BAS subcontractor’s cost and not the owner or engineer.

This specification Section 23 09 93 is an extension of Specification Section 23 09 23. All items mentioned in Section 23 09 23 shall be tied to this section and all BAS contractors bidding this Section are responsible for both specifications.

- BAS contractor shall schedule and participate in a pre-construction integration meeting with all vendors providing BACnet/Modbus or other equipment that is being integrated to the BAS. **Sample graphics shall be submitted for owner and engineer review**. **The meeting is a requirement and shall include but not limited to:**
    - Communications Requirements (MSTP/IP)
    - Points (Read/Write)
    - Connection Requirements (CAT5/6, 2-wire, 4-wire)
    - Coordinate Communication speeds when devices are MSTP.
    - Coordinate or Establish Device Instance Numbering System
    - Coordinate final points list(s) with owner/engineer

- Equipment provider must provide a certified controls start-up technician in order to assist with integration. This includes but is not limited to the following:
    - Inputting the device address, MAC address or IP address. (If equipment is to be BACnet/IP the equipment manufacturer shall be responsible for making sure the equipment points are pulled into customers network)
    - Ensuring appropriate points mapped and enabled. Assistance with pulling in points onsite is to be included for ALL equipment with on-board controls. Equipment controls technician is to be onsite with BAS Controls tech.
    - Equipment point read/write option selection as needed.
    - All points pulled into onboard controller are reading properly through on-board controller and through the BAS interface, with points matching.
    - BACnet Priority levels are not holding out commands from BAS.
    - The controls contractor is not responsible if there is a differentiation in how the on-board controls are programmed compared to the design SOO.
    - Remote technical assistance is not to be the BAS controls responsibility in order to troubleshoot and diagnose control through BACnet

- No portion of the total contract will be declared substantially complete until the graphics and automatic temperature control system has been demonstrated to be complete and functioning as intended. The BAS system will be complete and functioning as intended when all of the space temperatures are maintained at plus or minus two degrees of set point.

EQUIPMENT SHALL BID AS AN ALTERNATE

- Provide new front-end system, system architecture, etc. with new thermographs illustrating current floor plan with current room names.

- Building Automation Systems subcontractor shall be responsible for providing and installing all control / communication wiring and associated conduit to all outdoor equipment from existing buildings. All exposed outdoor conduit shall be rated for outdoors.

- All new chillers and boilers shall be provided with a BACnet card from equipment manufacturer. BAS shall provide and install wiring and conduit for interface.

- BAS contractor shall provide monitoring of VFD fault contact for each drive and display the point on the graphical front-end.

- Where applicable, building automation systems sub-contractor shall provide and install step down transformers in each mechanical room and run low voltage communication wiring power loops to serve low voltage actuators installed at each Air Terminal Unit.

- Wireless controls are not acceptable.

1. CHILLED WATER PLANT – SINGLE CHILLER; CONSTANT VOLUME PUMPING

Central plant consists of a single air-cooled chiller with dedicated primary chilled water constant volume pump. **Chiller shall be provided with a BACnet interface card for read and write capability; BAS subcontractor to run communication wiring to chiller.**

Equipment Control Points
CHW supply temperature – AI
CHW return temperature – AI
Plant CHW flow – AI
Chiller amps/status –AI
Chiller reset – AO
Chiller enable – DO
Chiller alarm – DI
Chiller start/stop – DO
CHW (primary) pump status – DI
CHW (primary) pump start/stop – Hardwired interlock to chiller (BAS Contractor responsible for installing wire in conduit and to coordinate with chiller rep on termination and testing). The BAS system shall be responsible for starting the pumps during freeze protection.

Chilled Water System Activation
The chilled water system shall be activated by a request for cooling from any unit it supplies with chilled water. The number of cooling requests required and the length of time the requests must be received before activating the plant shall be operator adjustable.

Chiller Activation
When the chilled water system is restarted or activated, the BAS shall send a start signal to the chiller. A current switch shall prove status to the BAS control module and shall alarm at the central site if a switch is not made within 20 seconds (adjustable and recommended by chiller rep). When pump status has been proven for time desired and set by chiller rep through internal controls, the chiller will go through its start sequence and verification of flow. The chiller shall maintain its leaving water temperature by its own internal controls. If the chiller fails to start within 2 minutes (adjustable), the BAS shall alarm the central site. If the chiller trips an internal alarm, it shall notify the BAS system through a set of normally closed contacts. If the lead pump fails to start, the chiller shall start the standby pump as described above.

Chilled Water Temperature Control
The chiller's internal controls shall maintain its chilled water supply temperature set point of 42°F (adjustable).

Chiller Sequencing
When chilled water is no longer needed due to no requests for cooling from building air handler unit, the chiller shall no longer supply the chiller enable command.

The chiller shall run for a minimum of 10 minutes (adjustable) to prevent short cycling, and the chilled water pump shall continue to run for an additional 5 minutes (adjustable) to insure adequate flow during a planned shutdown.

Freeze Protection
When the outdoor air temperature drops to 34°F (adjustable) or below, the BAS shall open the chilled water valves for flow through the coils for freeze protection and the chilled water pump system shall be activated to run until the low ambient temperature ceases to exist. The BAS system is to provide an enable to the CHW pumps during freeze protection, even though the chiller shall start pumps for temperature control.

Equipment off Conditions
When the chilled water system is inactive, the chillers and chilled water pumps shall be off and isolation valves closed.

2. HEATING WATER SYSTEM – SINGLE BOILER, CONSTANT VOLUME PUMPING

The heating water system consists of a single condensing boiler hot water system with a primary pump. The boiler system shall be controlled by a sequencing panel provided by the boiler manufacturer equipped with a BACnet interface card for each boiler. The BAS contractor shall provide a BACnet interface to each boiler to communicate with the sequencing panel to request the heating water system and monitor pertinent data from the boilers such as but not limited to leaving water temperature, status, alarm, etc.

BAS shall provide low voltage control wiring and conduits connecting the boilers and for the end devices. BAS to install wiring for the low water cutoff switch and the HWS system loop sensors and coordinate termination with boiler rep.

Equipment Control Points:
Building HW supply temperature - AI
Building HW return temperature – AI
Building HW return flow meter – AI
Boiler HW supply temperature – AI
Boiler HW system temperature sensor – HW Interlock
HW pump status – DI
HW pump start/stop – DO
Boiler status – dry contacts – DI
Boiler Alarm - DI
Boiler enable - DO
HW Pump enable, each pump – DO

Heating Water System Activation
The heating water pump shall be activated by a request for heating from any equipment it supplies with heating water. A current switch shall prove status to the BAS and shall alarm at the central site if the contacts are not made within 20 seconds (adjustable). There will also be a 10 second (adjustable) de-

bounce time to prevent nuisance alarms. If the heating water pump fails to start, the BAS shall alarm the operator. Once a heating water pump has proven positive flow, the BAS shall request the boiler system to run. Whenever the boiler is deactivated, the hot water pump will continue to run for 3 minutes (adjustable) to avoid excessive temperature buildup within the boiler.

If the boiler is commanded to run and the hot water supply temperature is less than 110°F (adjustable) for 40 minutes or the building hot water pump status is not indicating the building hot water pump is running, the BAS control module shall broadcast that hot water is not available.

Heating Water Temperature Control
The BAS control module shall receive inputs from sensors located in the boiler hot water supply and return piping. Boiler shall maintain the desired building heating water temperature.

Heating Water Temperature Reset: The heating water shall have a ratio
Reset based on outside air temperature and the following schedule:

Outside Air Temp	Less than 50°F	Hot Water Temp	160°F
Outside Air Temp	Greater than 70°F	Hot Water Temp	100°F

Freeze Protection
When the outdoor air temperature drops to 34°F (adjustable) or below, the BAS shall open the hot water valves for flow through the coils for freeze protection. The hot water system shall be activated to run and the building HW supply set point shall be set to 85°F (adjustable) while running the boiler only until the low ambient temperature ceases to exist or the building start-up time arrives.

3. SINGLE DUCT VAV AIR HANDLING UNITS WITH DEMAND CONTROL VENTILATION (RTU-2-01 & RTU-2-02)

Equipment Control Points
Supply air temperature – AI
Discharge air temperature (each coil) – AI
Supply air duct static pressure – AI
Airflow Measuring Station – AI
Fan status – DI
High Static pressure limit – DI
Fan start/stop – DO
Fan speed control – AO
Chilled water valve control - AO
OA damper control – AO
OA damper with end switch – DO
UVC Emitter – HW Interlock to fan so that device is enabled during occupancy and disabled during unoccupied times
Freeze stat – DI

AHU Activation
Each Single Duct variable air volume air handler shall be activated by a time-of-day schedule and shall broadcast an occupancy command to the associated terminal units.

Fan Control
When the air handler is scheduled to run, the B.A.S. controller will send signal to the air handler inverter, which will energize the fan. A current switch will prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There will also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing

switch. A run request will be sent to the Chilled Water System when the air-handling unit is active, and cooling is required.

Cold Deck Temperature Control
When the air handling unit is in occupied mode and cooling is required, the BAS shall send a request for cooling to the chiller plant and shall modulate the chilled water control valve to maintain leaving air temperature setpoint (55 °F, adjustable). The BAS shall have the ability to reset the leaving air temperature based on cooling request. When there are no cooling requests, the leaving air temperature setpoint shall reset up to a maximum of 58 °F (adjustable). When 2 (adjustable) or more cooling requests are present, the leaving air temperature setpoint shall reset down to 52 °F (adjustable). The reset shall not exceed more than 0.2 °F (adjustable) every 3 minutes (adjustable).

Air Volume Control
While the air handling unit is active, the BAS shall maintain the duct static pressure setpoint at 1.5" w.g. (adjustable, final setpoint to be determined by TAB contractor) by modulating the speed of the supply fan through a variable speed drive (VSD). A static pressure sensor mounted two-thirds down the longest duct run shall monitor the duct static pressure. A manual-reset static pressure high limit switch shall monitor the static pressure of the supply duct. If the duct static pressure rises above 3.0" w.g. (locally adjustable) the air handling unit shall be de-energized via hard-wire interlock to the VFD safety circuit. The BAS shall monitor the high static limit switch and shall display an alarm at the central site. The static pressure high limit switch must be manually reset.

The static pressure shall reset to achieve a target damper setpoint of 85% with a 5% dead-band. Static pressure shall reset by not more than 0.2” W.C. every 3 minutes. Static pressure shall be a minimum of 0.5” W.C.

Outside Air Volume Control
The outside airflow shall be measured by the flow measuring station and reported to the BAS. The BAS shall increase and decrease the outside airflow of the makeup air unit based on the number of exhaust

Demand Control Ventilation
When the air handler is running it the occupied mode, the O.A. damper control shall be enabled and a request to run shall be sent to the CHW or HW Plant. A CO_2 sensor mounted in various spaces (see series fan powered box sequence) shall monitor the CO_2 level in the spaces. The B.A.S. shall select the highest level or average (user adjustable from settings page) to modulate the OA damper. The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO_2 level at between 850 ppm and 1,000 ppm (all adjustable). The OA dampers minimum and maximum positions shall be determined with the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM.

The outside air damper shall remain closed, and the OAHU shall remain off even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

Unoccupied Control
The AHU shall monitor the space temperature sensors and give the ability to select the high/low or average of the accumulation. If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F (adjustable) heating and 95°F (adjustable) cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints. All values are operator adjustable.

Associated Equipment
During the occupied time period, a request to run shall be sent to the corresponding exhaust fans. The exhaust fans associated with the air handler shall be energized only during the occupied time period.

The exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on an outdoor air shutdown schedule.

Equipment off Conditions
When the air handling unit is de-energized, the cooling valve shall be closed, the outside air damper shall be closed, UVC emitter disabled and any associated exhaust fans and outside air dampers shall be de-energized.

Freeze Protection
A manual reset low-limit temperature switch shall be mounted in the discharge air stream of the heating coil. The normally closed contacts of the switch shall be wired in series with the VSD safety interlock circuit so that, when activated, the VSD will shut down the fan. Upon sensing a low limit condition, the BAS shall open the HW and CHW control valves, close the outdoor air damper, energize the hot water pump and boiler (see heating water sequence of operation), and alarm at the central site.

4. SINGLE ZONE VAV AIR HANDLING UNITS WITH HUMIDITY CONTROL AND DEMAND CONTROL VENTILATION (RTU-1-03)

Equipment Control Points
Space temperature – AI
Space humidity – AI
Space CO2 level(s) – AI (combo space, humidity and CO2 is acceptable)
Discharge CHW coil air temperature – AI
Discharge reheat HW coil air temperature – AI
Airflow Measuring Station – AI
Fan status – DI
Air Handling Unit Fan start/stop – DO
Fan speed control – AO
Chilled water valve control – AO
Hot water valve control - AO
Outside air damper control – AO
OA damper with end switch – DO
UVC Emitter – HW Interlock to fan so that device is enabled during occupancy and disabled during unoccupied times
Freeze stat – DI

AHU Activation
The air-handling unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature verses the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The air-handling unit control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Fan Control
When the air handler is requested to run, the B.A.S. control module shall send an enable signal to the air handler inverter, which will energize the fan. A current switch shall prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There shall also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms. A run request shall be sent to the Chilled Water System when the air-handling unit is active, and cooling is required. A run request shall be sent to the Heating Water System when the air-handling unit is active, and heating is required. As the zone temperature rises,

the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed (determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

Temperature Control
A wall mounted space temperature sensor shall monitor the air temperature in the space. The B.A.S. shall output separate signals to modulate the chilled water and heating water control valve actuators in sequence to maintain the space temperature within its operator adjustable heating and cooling setpoints. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed (determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

Outside Air Volume Control
The outside airflow shall be measured by the flow measuring station and reported to the BAS. The BAS shall modulate the motorized damper to maintain the scheduled outside air cfm.

Demand Control Ventilation
When the air handler is running it the occupied mode, the O.A. damper control shall be enabled and a request to run shall be sent to the OAHU that supplies the unit with outside air. A CO_2 sensor mounted in the space shall monitor the CO_2 level in the spaces. The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO_2 level at between 850 ppm and 1,000 ppm (all adjustable). The OA dampers minimum and maximum positions shall be determined with the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM.

The outside air damper shall remain closed, and the OAHU shall remain off even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

Space Humidity Control
A space humidity sensor, monitored by the B.A.S., shall set the cooling coil discharge air setpoint to 55^0F (adjustable) and modulate the chilled water valve to maintain the setpoint if the humidity rises above 60% (adjustable) and continue until it falls by 5% (adjustable). The B.A.S. shall modulate the hot water reheat valve to maintain the space temperature between its heating and cooling setpoints. If the B.A.S. control module is receiving a broadcast from the HW system that heating water is not available (see Heating Water System sequence of operations) the chilled water valve shall not be overridden until heating water is available. The fan will run at a fixed speed (determined by the TAB contractor) while in dehumidification mode.

Unoccupied Control
If the space temperature reaches the operator adjustable unoccupied setpoints of 55^0F (adjustable) heating and 95^0F (adjustable) cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints. All values are operator adjustable.

Associated Equipment
During the occupied time period, the outside air damper shall be open. The exhaust fans associated with the air handler shall also be energized only during the occupied time period. The outside air dampers shall remain closed, the exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on an outdoor air shutdown schedule. The Exhaust fans shall be commanded (off) during morning cool down / warm up and shall only turn on during the occupied time periods. General exhaust fans may require a separate schedule to accomplish this sequence and will be part of the commissioning sequence of operations to be demonstrated.

EQUIPMENT SHALL BID AS AN ALTERNATE

Equipment off Conditions
When the air-handling unit is de-energized, its chilled water valve, hot water valve, UVC emitter disabled and OA damper shall be closed. The related exhaust fans shall be de-energized and the request to run to the OAHU shall be canceled. While the units are off if the outside air temperature falls below 34°F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the secondary pumps shall run for freeze protection.

Freeze Protection
A manual reset low-limit temperature switch shall be mounted in the discharge air stream of the heating coil. The normally closed contacts of the switch shall be wired in series with the VSD safety interlock circuit so that, when activated, the VSD will shut down the fan. Upon sensing a low limit condition, the BAS shall open the HW and CHW control valves, close the outdoor air damper, energize the hot water pump and boiler (see heating water sequence of operation), and alarm at the central site.

5. SINGLE ZONE VAV AIR HANDLING UNITS WITH HUMIDITY CONTROL (RTU-1-01 & RTU-1-02)

Equipment Control Points
Space temperature – AI
Space humidity – AI
Discharge CHW coil air temperature – AI
Discharge reheat HW coil air temperature – AI
Airflow Measuring Station – AI
Fan status – DI
Air Handling Unit Fan start/stop – DO
Fan speed control – AO
Chilled water valve control – AO
Re-heat hot water valve control – AO
Pre- heat hot water valve control - AO
Outside air damper control – AO
OA damper with end switch – DO
UVC Emitter – HW Interlock to fan so that device is enabled during occupancy and disabled during unoccupied times
Freeze stat – DI

AHU Activation
The air-handling unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature verses the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The air-handling unit control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Fan Control
When the air handler is requested to run, the B.A.S. control module shall send an enable signal to the air handler inverter, which will energize the fan. A current switch shall prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There shall also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms. A run request shall be sent to the Chilled Water System when the air-handling unit is active, and cooling is required. A run request shall be sent to the Heating Water System when the air-handling unit is active, and heating is required. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed

(determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

Temperature Control
A wall mounted space temperature sensor shall monitor the air temperature in the space. The B.A.S. shall output separate signals to modulate the chilled water and heating water control valve actuators in sequence to maintain the space temperature within its operator adjustable heating and cooling setpoints. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed (determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

If heating is required, pre-heat coil shall modulate the preheat water control valve actuator to maintain discharge air temperature of 50°F (adjustable).

Outside Air Volume Control
The outside airflow shall be measured by the flow measuring station and reported to the BAS. The BAS shall modulate the motorized damper to maintain the scheduled outside air cfm.

Space Humidity Control
A space humidity sensor, monitored by the B.A.S., shall set the cooling coil discharge air setpoint to 55°F (adjustable) and modulate the chilled water valve to maintain the setpoint if the humidity rises above 60% (adjustable) and continue until it falls by 5% (adjustable). The B.A.S. shall modulate the hot water reheat valve to maintain the space temperature between its heating and cooling setpoints. If the B.A.S. control module is receiving a broadcast from the HW system that heating water is not available (see Heating Water System sequence of operations) the chilled water valve shall not be overridden until heating water is available. The fan will run at a fixed speed (determined by the TAB contractor) while in dehumidification mode.

Unoccupied Control
If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F (adjustable) heating and 95°F (adjustable) cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints. All values are operator adjustable.

Associated Equipment
During the occupied time period, the outside air damper shall be open. The exhaust fans associated with the air handler shall also be energized only during the occupied time period. The outside air dampers shall remain closed, the exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on an outdoor air shutdown schedule. The Exhaust fans shall be commanded (off) during morning cool down / warm up and shall only turn on during the occupied time periods. General exhaust fans may require a separate schedule to accomplish this sequence and will be part of the commissioning sequence of operations to be demonstrated.

Equipment off Conditions
When the air-handling unit is de-energized, its chilled water valve, hot water valve, UVC emitter disabled and OA damper shall be closed. The related exhaust fans shall be de-energized and the request to run to the OAHU shall be canceled. While the units are off if the outside air temperature falls below 34°F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the secondary pumps shall run for freeze protection.

Freeze Protection
A manual reset low-limit temperature switch shall be mounted in the discharge air stream of the heating coil. The normally closed contacts of the switch shall be wired in series with the VSD safety interlock circuit so that, when activated, the VSD will shut down the fan. Upon sensing a low limit condition, the

EQUIPMENT SHALL BID AS AN ALTERNATE

BAS shall open the HW and CHW control valves, close the outdoor air damper, energize the hot water pump and boiler (see heating water sequence of operation), and alarm at the central site.

6. SERIES FAN POWERED AIR TERMINAL UNIT (CVB) – WITH HOT WATER HEAT

Equipment Control Points
Space temperature – AI
Discharge temperature - AI
Cold deck flow – AI
Fan Start/stop – DO
Fan Status - DI
Cooling damper – FM
Re-heat valve – AO

Zone Occupancy
The parent AHU shall have an occupancy schedule assigned to it. Upon occupancy the AHU shall broadcast an occupancy signal to the terminal unit,

When the CVB Boxes calculated start, time arrives its internal fan motor shall be energized and continue to run until the unoccupied period arrives.

Temperature Control
When the zone becomes active, the CVB controller shall determine, based on the space temperature, whether heating or cooling is required. If cooling is required, the cooling air damper shall be modulated open to its operator adjustable maximum cooling CFM setpoint and cool request shall be sent to the air handling unit serving the CVB. As the space temperature returns to setpoint, the CVB cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint.

The cooling damper actuator shall use a stepper motor so its position can be accurately tracked for display on the CVB graphic and collected by the air-handling unit serving the CVB to reset the air handling unit static pressure setpoint.

If heating is required, a run request will be sent to the heating water system (See Hot Water Sequence of Operation). The CVB terminal damper will be maintained at its adjustable minimum heating CFM setpoint, and the hot water reheat valve will be modulated (0-10v) to maintain the space temperature.

Unoccupied Control
During the unoccupied time period, the CVB cooling damper shall be open (operator adjustable) and its fan shall be de-energized. If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F heating and 95°F cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints.

7. COOLING ONLY VAV TERMINAL BOX UNITS

Equipment Control Points
Space temperature – AI
Discharge temperature - AI
Cold deck flow - AI
Cooling damper – FM

Temperature Control

EQUIPMENT SHALL BID AS AN ALTERNATE

When the zone becomes active, the VAV controller shall determine based on the space temperature, if cooling is required. If cooling is required, the cooling air damper shall be modulated open to its maximum cooling CFM setpoint (adjustable) and a run request shall be sent to the air handling unit serving the VAV. As the space temperature returns to setpoint, the VAV cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint (30% of maximum).

Unoccupied Control
During the unoccupied time period, the VAV cooling damper shall be closed (adjustable). If the space temperature reaches the operator adjustable unoccupied setpoint of 85°F (adjustable) cooling, alarm shall be sent to the central site.

8. DUCTLESS MINI-SPLIT-SYSTEM AIR CONDITIONERS

The split systems shall have a factory furnished controller and operate stand-alone based on unit thermostat. The BAS shall monitor the space temp only.

Equipment Control Points
Space temperature – AI

9. GENERAL EXHAUST

Equipment Control Points
Exhaust fan status – Current switch - DI
Exhaust fan enable – DO (interlocked to damper)

Interlock all general exhaust fans to run with outside air handling equipment serving the same area and run only during the occupied mode with their OA Dampers open. The EF shall be provided with OA dampers built into the curb adapter and shall be powered and operate from same circuit powering the fans. Dampers and actuators to be provided by the EF manufacture. The exhaust fans shall remain off even during the scheduled occupancy time based on a global command from a shelter in place (building shutdown) button or based on a summer mode schedule.

10. VARIABLE FREQUENCY DRIVES INTERFACE

Equipment Control Points
Start/stop – DO
Alarm – DI
Last fault – AI
Reset – DO
% Output – AI
Frequency output – AI
Speed – AI
Current – AI
Power – AI
Drive temperature – AI
KW – AI
Runtime - AI

The BAS shall interface directly to each variable speed drive and report all information to the central site.

11. ELECTRIC UNIT HEATERS

EQUIPMENT SHALL BID AS AN ALTERNATE

Electric unit heaters shall be controlled by a factory furnished thermostat. BAS contractor shall install and wire thermostat.

12. OUTDOOR AIR CONDITIONS

Equipment Control Points
Outdoor air temperature – AI
Outdoor air humidity – AI

The new sensors shall be mounted in an area on the north side of the building where the representative temperature and humidity can be monitored, both shall have sun shields. Based on the outside air temperature and humidity the BAS shall calculate the outdoor enthalpy, wet bulb, and dew point temperatures. The outdoor air temperature and humidity shall be broadcast as global information for use by the other control programs.

13. EMERGENCY SHUTDOWN (SHELTER IN PLACE)

Equipment Control Points
Shutdown switch status – dry contact – DI

Provide a single mushroom style pushbutton adjacent to fire alarm control panel. Operation shall be pushbutton off, keyed switch on. Provide clear plastic cover to prevent accidental activation. Provide engraved identification tag with “Emergency HVAC Shutdown”. When activated, the BAS shall shut down the HVAC system and close all intake, exhaust, and relief dampers. The button must be manually reset (via key) to allow the HVAC system to resume normal operation. Confirm location with owner prior to installation.

14. HVAC TIMED LOCAL OVERRIDE (TLO)

Equipment Control Points
Override button input – DI

A local override button located as directed by the owner shall allow temporary override of the entire system. Each press of the button shall place the system in occupied mode for 30 minutes (adjustable), to a maximum of 2 hours (adjustable).

An additional local override button located in the hall of the administration area shall override the VRF system for up to 3 hours. The TLO button shall be in a lockable, password protected clear enclosure. Verify location of the TLO with owner.

15. COOL-DOWN CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air units and associated air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the cool-down cycle shall be regulated by the BAS optimum start/stop routine. The cool-down cycle shall continue until all space temperatures are at or below the setpoint. Cool-down cycle shall not be initiated when outside air temperature is less than 80°F.

16. WARM-UP CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the warm-up cycle shall be regulated by the BAS optimum start/stop routine. The

warm-up cycle shall continue until all space temperatures are at or above the setpoint. Warm-up cycle shall not be initiated when outside air temperature is greater than 70°F.

17. LOAD SHEDDING / DEMAND REDUCTION

The units shall be programmed to accept a global command via software so that the cooling and heating setpoints for those units can be relaxed, OA can be limited, equipment can be shutdown, and/or the plant load can be reduced. A dashboard will be provided in the front-end for different levels of reduction to be programmed into the units. Owner shall be able to enact different levels of reduction through a software button or via schedule. A minimum of six levels of reduction shall be available for configuration. The dashboard shall represent the average reduction for each level for no less than 50 samples.

18. EXTERIOR LIGHTING CONTROL

Equipment Control Points
Lighting contactor enable/disable - DO
Photocell - DI

The BAS contractor shall provide separate outputs for each contactor indicated on the electrical drawings. Each contactor shall be able to be controlled via operator defined schedule independently or in groups defined by the operator. Provide a photocell for monitoring by the BAS. Exterior lighting shall be turned off if the photocell senses light levels above a pre-determined limit.

Contractor shall program to allow the operator to select whether the system utilizes a boundary schedule and sunrise/sunset calculations. If the exterior lights are scheduled to operate, the operator shall have the option to select to enable them for an adjustable time period before or after sunset and disable for and adjustable time period before or after sunrise.

Override
Provide a method of manual override in an easily accessible location (i.e., control relay with integral hand-off-auto in control panel).

19. DOMESTIC WATER HEATER

Equipment Control Points
Domestic HW circulation pump enable/disable – DO
Domestic HW heaters enable/disable – DO
Domestic HW circulation pump status – DI
Domestic HW heaters status – DI
Domestic Leaving Water Temp Sensor Status – AI

The BAS shall provide enable/disable control of each gas water heater (GWH). Heaters shall be enabled / disabled based on an operator defined occupancy schedule. A current switch will monitor the status of each system and report back to the BAS.

20. BUILDING RELIEF HOODS

Equipment Control Points
Isolation Damper OPEN/ CLOSE – DO

Damper Position Status - DI

EQUIPMENT SHALL BID AS AN ALTERNATE

The BAS shall OPEN each motorized relief damper when the associated area is occupied. An internal / duct mounted (refer to drawings for duct mounted) barometric damper shall OPEN/ CLOSE according to interior building air pressure.

In the event of a Shelter in Place shutdown all motorized relief dampers shall be CLOSED.

END OF SECTION 23 09 93

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot water heating piping.
2. Chilled water piping.
3. Condenser water piping.
4. Make-up water piping.
5. Condensate-drain piping.
6. Blowdown drain piping.
7. Air-vent piping.

B. Related Sections include the following:

1. Section 23 21 23 "Hydronic Pumps" for pumps, motors, and accessories for Hydronic piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be 150 PSI pressure class unless otherwise noted or required by project conditions.

1.5 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.

B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.

C. Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

D. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.6 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.

2. RTRP and RTRF with adhesive.

3. Pressure-seal fittings.

C. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops. The Pipe shop drawings shall be superimposed on the architectural backgrounds.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control test reports.

C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used.

E. Test Reports: Indicate results of refrigerant leak test and acid test.

F. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.8 QUALITY ASSURANCE

A. All pipe and accessories shall be of United States domestic manufacture.

B. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

C. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

F. Perform Work in accordance with ASME B31.5 code for installation of piping systems and ASME Section IX for welding materials and procedures.

G. Maintain one copy of each document on site.

H. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.9 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Division 1 - General Requirements.

B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.

D. Contractor shall adequately protect piping from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

E. Do not deliver piping to the project site until progress of construction has reached the stage where piping is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.10 WELDING

A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and "Standard Qualifications for Welding Procedures, Welders and Welding Operators."

B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.

C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type B).

B. Wrought-Copper Fittings: ASME B16.22.

1. Housing: Ductile Iron.

2. Gasket: EPDM, Grade EHP
3. Pipe Sizes 2” and larger
4. Tools: Manufacturer's grooving tools.
5. Minimum 300-psig working-pressure rating at 250 deg F.

C. Copper or Bronze Pressure-Seal Fittings:

1. Housing: Copper.
2. O-Rings and Pipe Stops: EPDM.
3. Pipe Sizes 2” and down
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F.

D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53 Electric Resistance Weld (ERW), Type E, Grade B, Schedule 40 black steel with plain ends; application as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.

D. Malleable-Iron Unions: ASME B16.39; Classes 150.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 250.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.

B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings; ASTM F 439 for Schedule 80 pipe.

C. PVC Plastic Pipe: ASTM D 1785, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.

D. PVC Plastic Pipe Fittings: Socket-type pipe fitting; ASTM D 2467 for Schedule 80 pipe.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.

a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Charlotte Pipe and Foundry Company.
    b. IPEX Inc.
    c. KBi.

2. CPVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Charlotte Pipe and Foundry Company.
    b. IPEX Inc.
    c. KBi.
    d. NIBCO INC.

2. MSS SP-107, CPVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Hart Industries International, Inc.
    d. Jomar International Ltd.
    e. Matco-Norca, Inc.
    f. McDonald, A. Y. Mfg. Co.
    g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    h. Wilkins; a Zurn company.

2. Description:

    a. Standard: ASSE 1079.
    b. Pressure Rating: 150 psig minimum at 180 deg F.
    c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Matco-Norca, Inc.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    e. Wilkins; a Zurn company.

2. Description:

    a. Standard: ASSE 1079.
    b. Factory-fabricated, bolted, companion-flange assembly.
    c. Pressure Rating: 150 psig minimum at 180 deg F.
    d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.

2. Description:

    a. Non-conducting materials for field assembly of companion flanges.
    b. Pressure Rating: 150 psig.
    c. Gasket: Neoprene or Phenolic.
    d. Bolt Sleeves: Phenolic or polyethylene.
    e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elster Perfection.
    b. Matco-Norca, Inc.
    c. Precision Plumbing Products, Inc.
    d. Victaulic Company.

2. Description:

    a. Standard: IAPMO PS 66
    b. Electroplated steel nipple. Complying with ASTM F 1545.
    c. Pressure Rating: 300 psig 225 deg F.
    d. End Connections: Male threaded or grooved.
    e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot water heating, chilled water, and condenser water, above ground, NPS 2 and smaller, shall be the following:

1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot water heating, chilled water, and condenser water above ground, NPS 2-1/2 and larger, shall be one of the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Chlorinated pool heating-water piping, shall be the following:

1. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.

D. Makeup-water piping installed aboveground shall be the following:

1. ASTM B 88, Type K (ASTM B 88M, Type B) drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

E. Condensate-Drain Piping: ASTM B 88, Type L (ASTM B 88M, Type B) hard drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

F. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blow-down drain is installed.

G. Air-Vent Piping:

1. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping**,** NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping."

U. Install lateral bracing with pipe hangers and supports to prevent swaying.

V. Identify piping as specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

W. Install sleeves for piping penetrations of walls, ceilings, and floors.

X. Install mechanical sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for mechanical sleeve seals specified in Section 23 05 29 - “Hangers and Supports for HVAC Piping and Equipment”.

Y. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 – “Hangers and Supports for HVAC Piping and Equipment”.

Z. Provide access doors where valves and fittings are not accessible.

AA. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

BB. Provide unions or flanges and isolation valves at each connection to a piece of equipment or control valve; accessory which requires removal for maintenance. Screwed unions should be used for two (2) inches IPS and smaller. Locate joints where they can be accessed for repair. Screw or flanged joints shall not be permitted above inaccessible ceilings or in chases.

CC. All piping shall be installed to eliminate traps and pockets. Where air pockets or water trap cannot be avoided, provide means for drainage with valved hose connections for water trap and air vents for air pockets. Provide drain valves at low points of the system.

DD. For pipe inside building, install parallel to lines of building, close to columns and walls vertical pipe shall be truly vertical. Spring or forcing piping into place will not be permitted. Install pipe to prevent strain on equipment connections.

EE. Provide adequate access to all equipment, motorized valves, instruments, controls, and access panels.

FF. Allow easy draining of water piping, with drain valves at low points.

3.3 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

F. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

H. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

J. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.

4. PVC Non-pressure Piping: Join according to ASTM D 2855.

K. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

L. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.4 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

3.5 FIELD QUALITY CONTROL

A. Prepare Hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, un-insulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush Hydronic piping systems with clean water; then remove and clean or replace strainer screens.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on Hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that Hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least one hour, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.

2. Inspect pumps for proper rotation.

3. Set makeup pressure-reducing valves for required system pressure.

4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of Hydronic equipment, such as boilers, chillers, cooling towers, to specified values.

7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. In-line circulators
2. Split-Coupled Vertical In-line pumps
3. Automatic Condensate Pump Units

B. Related Sections:

1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment - Mechanical Vibration Control: Product requirements for vibration isolators required with pumps.

1.3 REFERENCES

A. Underwriters Laboratories Inc.:

1. UL 778 - Motor Operated Water Pumps.

1.4 PERFORMANCE REQUIREMENTS

A. Provide pumps electrical characteristics in accordance with Division 26 and schedules on Drawings.

1.5 SUBMITTALS

A. Submit in accordance with Division 1 and Section 23 05 00.

B. Provide line-by-line specification review annotated to certify compliance or deviation.

C. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Provide parallel pump curves indicating the non-overloaded motor horsepower for single pump operation when applicable. Include NPSH curve with operating point plotted when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.

D. Shop Drawings: For each pump.

1. Show pump layout and connections.

2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

3. Include diagrams for power, signal, and control wiring.

E. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 1, General Requirements.

B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.7 WARRANTY

A. Furnish one (1) year manufacturer parts and labor warranty for pumps. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.

1. Furnish one (1) set of mechanical seals for each pump installed.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Pumps shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer’s protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect

the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.11 PUMP IDENTIFACTION REQUIREMENTS

A. Furnish each pump with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Unit identification as indicated within Contract Documents.
- Serial Number.
- Model Number.
- Flow rate (GPM) and head (ft. H20).
- Motor Horsepower.
- RPM
- Power Supply: Volts / PH / Amps.
- Sales Order #.
- Date of unit manufactured.

B. For chilled water pumps, in addition to the base mounted identification tag provide an additional identification tag shipped loose for contractor to install on external rigid insulation board.

PART 2 – PRODUCTS

2.1 IN-LINE CIRCULATORS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Pentair / Aurora
2. Armstrong
3. Bell and Gossett
4. Patterson
5. Taco

B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psig maximum working pressure.

C. Casing: Cast iron, with flanged pump connections.

D. Impeller: Cast bronze, dynamically balanced and keyed to shaft.

E. Bearings: Two oil lubricated bronze sleeves.

F. Shaft: Stainless steel with copper or bronze sleeve, integral thrust collar.

G. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.

H. Drive: Flexible coupling.

I. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.2 "SPLIT-COUPLED" VERTICAL IN-LINE PUMPS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Pentair / Aurora
2. Armstrong
3. Bell and Gossett
4. Patterson
5. Taco

B. Type: Vertical shaft, single stage, direct connected, radial split casing, for 175 psig maximum working pressure.

C. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connections with factory installed seal flush line, recessed cast iron drain pan with threaded connection for field piping to drain, flanged suction and discharge.

D. Impeller: 316 stainless steel, fully enclosed, dynamically balanced, and keyed to shaft.

E. Bearings: Grease or permanently lubricated roller or ball bearings. Bearings shall have 40,000-hour minimum life.

F. Shaft: 416 stainless steel with stainless steel shaft sleeve.

G. Mechanical Seals: Stainless steel multi-spring outside balanced type with a Viton secondary seal, carbon rotating face and Silicon Carbide stationary seat. Provide 316 stainless steel gland plate with factory installed flush line with manual vent, 225 degrees Fahrenheit maximum continuous operating temperature.

H. Drive: Axially split, spacer type rigid coupling constructed of high tensile aluminum bar with OSHA approved coupling guard.

I. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

a. Enclosure: Outdoors: Totally enclosed, fan-cooled (TEFC).
b. Enclosure: Indoors: Open Drip Proof (ODP).
c. Efficiency: Premium efficient.
d. NEMA Design: MG-1.
e. Service Factor: 1.15.

2.3 AUTOMATIC CONDENSATE PUMP UNITS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Beckett Corporation
2. Hartell Pumps
3. Little Giant Pump Co.
4. Mepco, LLC.

B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory or field-installed check valve and a 72-inch minimum, electrical power cord with plug.

2.4 PUMP SUCTION DIFFUSER

A. Not applicable – shall be part of pump isolation drop, coordinate with Victaulic. Coordinate suction diffuser size with Victaulic for seamless connection. Refer to 23 05 23; 2.2 for further information.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Provide pumps to operate at specified system fluid temperatures and scheduled capacities. Pumps shall operate without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories. Provide no less than the minimum as required by the manufacturer.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping

D. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

2. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

E. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled, split coupled vertical in-line or base mounted pumps; install supports under elbows on pump suction and discharge line sizes four (4) inches and over.

F. Provide air cock and drain connection on horizontal pump casings.

G. Provide drains for bases and seals. Route to floor drain.

H. Lubricate pumps before start-up according to manufacturer’s instructions.

3.3 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Discharge side of pumps install Victaulic Vic-300 non-slam check valve, Victaulic Vic-300 combination shut-off butterfly valve and throttling valve with memory stop.

F. Suction side of pumps install Victaulic Series 731 suction diffuser with type 304 stainless steel strainer and Victaulic Vic-300 shut-off butterfly valve on suction side of pumps.

G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping or install single gage with multiple-input selector valve.

3.4 STARTUP SERVICE

A. Start up service shall be performed by a factory authorized direct service technician. Start up work shall not be performed by installing mechanical contractor.

1. Complete installation and startup checks according to manufacturer's written instructions.

a. Check piping connections for tightness.

b. Clean strainers on suction piping.

c. Perform the following startup checks for each pump before starting:

1. Verify bearing lubrication.

2. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If

pump is bound or drags, do not operate until cause of trouble is determined and corrected.

3. Verify that pump is rotating in the correct direction.

d. Prime pump by opening suction valves and closing drains and prepare pump for operation.

e. Start motor.

f. Open discharge valve slowly.

3.5 DEMONSTRATION

A. Demonstration shall be performed by a factory authorized direct service technician. Demonstration shall not be performed by installing mechanical contractor.

1. Train owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

2. Provide documentation of owner training in close out submittal.

END OF SECTION 23 21 23

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Refrigerant piping.
2. Refrigerant Insulation.
3. Unions, flanges, and couplings.
4. Refrigerant moisture and liquid indicators.
5. Valves.
6. Refrigerant strainers.
7. Refrigerant pressure regulators.
8. Refrigerant pressure relief valves.
9. Refrigerant filter-driers.
10. Refrigerant solenoid valves.
11. Refrigerant expansion valves.
12. Electronic expansion valves.
13. Refrigerant receivers.

B. Related Sections:

1. Section 31 00 00 - Earthwork: Earthwork for backfill in trenches.
2. Section 31 23 16.13 – Trenching and Backfilling: Execution requirements for trenching and backfilling required by this section.
3. Section 07 84 00 - Firestopping: and Fire Safing Product requirements for firestopping for placement by this section.
4. Section 08 31 13 - Access Doors: Access doors for concealed valves and accessories.
5. Section 09 91 00 - Painting and Staining: Product requirements for painting for placement by this section.

6. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and sleeves for placement by this section.

7. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.

8. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.

9. Section 23 07 19 - HVAC Piping Insulation: Product requirements for Piping Insulation for placement by this section.

10. Section 23 21 13 - Hydronic Piping: Piping materials for refrigerant systems.

1.3 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 495 - Refrigerant Liquid Receivers.

2. ARI 710 - Liquid-Line Driers.

3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.

4. ARI 750 - Thermostatic Refrigerant Expansion Valves.

5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

C. American Society of Mechanical Engineers:

1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

3. ASME B31.5 - Refrigeration Piping.

4. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. ASTM International (ASTM):

1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

2. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

3. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

5. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.

E. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

2. AWS D1.1 - Structural Welding Code - Steel.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

G. Underwriters Laboratories Inc.:

1. UL 429 - Electrically Operated Valves.

1.4 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig.
2. Suction Lines for Heat-Pump Applications: 380 psig.
3. Hot-Gas and Liquid Lines: 380 psig.

B. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

1.5 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.

C. Provide pipe hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

D. Provide receivers sized to accommodate pump down charge.

E. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

1.6 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Submit in Accordance with Division 1 - General Requirements.

C. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.

D. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.

E. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories.

2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

3. Hangers and Supports: Submit manufacturers catalog information including load capacity.

4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:

a. Refrigerant moisture and liquid indicators.

b. Refrigerant strainers.

c. Refrigerant pressure regulators.

d. Refrigerant pressure relief valves.

e. Refrigerant filter-driers.

f. Refrigerant solenoid valves.

g. Refrigerant expansion valves.

h. Electronic expansion valves.

F. Test Reports: Indicate results of piping system pressure test.

G. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.

H. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

I. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves, equipment, and refrigerant accessories.

B. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.8 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years experience.

B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three (3) years experience approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Division 1- General Requirements.

B. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.

C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

F. Contractor shall adequately protect material from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

G. Do not deliver Piping to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.11 WARRANTY

A. Furnish five (5) year manufacturer warranty for valves excluding packing.

1.12 MAINTENANCE MATERIALS

A. Furnish two (2) refrigerant oil test kits each containing everything required for conducting one test.

1.13 EXTRA MATERIALS

A. Furnish two (2) packing kits for each size and valve type.

B. Furnish two (2) refrigerant filter-dryer cartridges of each type.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

A. Copper Tubing: ASTM B 280, Nitrogenized Type L - ACR hard drawn.

1. Wrought-copper Fittings: ASME B16.22.

2. Brazing Filler Metals: AWS A5.8. BCuP: minimum 15% silver (Ag), 5% phosphorous (P), and balance copper (Cu).

3. Final product composition shall be 99% pure copper and lead free.

4. Provide in 10 ft. and 20 ft. straight tube lengths.

5. **Bendable pipe of any kind shall not be accepted.**

2.2 UNIONS, FLANGES, AND COUPLINGS

A. Two (2) inches and Smaller:

1. Copper Pipe: Bronze, soldered joints.

B. 2-1/2 inches and Larger:

1. Copper Piping: Bronze
.
2. Gaskets: 1/16-inch-thick preformed neoprene.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 REFRIGERANT MOISTURE AND LIQUID INDICATORS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.

2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division

3. Sporlan Valve Co.

B. Indicators:

1. Port: Single, UL listed.
2. Body: Brass, solder ends.
3. Sight glass: Color-coded paper moisture indicator with removable element cartridge and plastic cap.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 200 degrees Fahrenheit.

2.4 VALVES

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
3. Sporlan Valve Co.

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet solder or flared ends.
2. Phosphor bronze and stainless-steel diaphragms, rising stem and hand wheel.
3. Stainless steel spring, nylon seats, disc with positive back seating.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 275 degrees Fahrenheit.

C. Packed Angle Valves:

1. Forged brass, solder ends.
2. Forged brass seal caps with copper gasket, rising stem and seat with back seating, molded stem packing.
3. Maximum working pressure: 500 psig
4. Maximum working temperature: 275 degrees Fahrenheit.

D. Ball Valves:

1. Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered ends.
2. Maximum working pressure: 500 psig and

3. Maximum working temperature: 300 degrees Fahrenheit.

E. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, solder ends.

2. Maximum working pressure: 500 psig.

F. Refrigerant Check Valves:

1. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

a. Alco Controls Div, Emerson Electric Co.

b. Parker Hannifin Corp., Refrigeration & Air Conditioning Division

c. Sporlan Valve Co.

2. Globe Type:

a. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless-steel spring, Teflon seat disc.

b. Maximum working pressure: 500 psig.

c. Maximum working temperature: 300 degrees Fahrenheit.

3. Straight Through Type:

a. Spring, neoprene seat.

b. Maximum working pressure: 500 psig.

c. Maximum working temperature: 250 degrees Fahrenheit.

2.5 REFRIGERANT STRAINERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.

2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division

3. Sporlan Valve Co. Model.

B. Straight Line or Angle Line Type:

1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless-steel wire or monel reinforced with brass.

2. Maximum working pressure: 430 psig.

2.6 REFRIGERANT PRESSURE REGULATORS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.

2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division

3. Sporlan Valve Co.

B. Brass body, stainless steel diaphragm, pilot operated with remote pressure pilot, adjustable over 0 to 80 psig range, for maximum working pressure of 450 psig.

2.7 REFRIGERANT PRESSURE RELIEF VALVES

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.

2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division.

3. Sporlan Valve Co.

B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; setting selected to ASHRAE 15.

2.8 REFRIGERANT FILTER-DRIERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.

2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division

3. Sporlan Valve Co.

B. Replaceable Cartridge Angle Type:

1. Shell: ARI 710, UL listed, steel, removable cap, for maximum working pressure of 500 psig, and wrought copper fittings for solder end connections.

2. Filter Cartridge: Pleated media with integral end rings, stainless steel support.

3. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumin to provide micronic filtration.

4. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets.

C. Permanent Straight Through Type:

1. ARI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 500 psig.

2. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.

2.9 REFRIGERANT SOLENOID VALVES

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.

2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division

3. Sporlan Valve Co.

B. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, solder ends; for maximum working pressure of 500 psig. Stem designed to allow manual operation in case of coil failure.

C. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture, and fungus proof, with surge protector and color-coded lead wires, integral junction box.

2.10 REFRIGERANT EXPANSION VALVES

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.

2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division

3. Sporlan Valve Co.

B. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb and remote bulb well.

C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum ten (10) degrees Fahrenheit superheat. Select to avoid being undersized at full load and oversized at part load.

2.11 REFRIGERANT PIPING INSULATION

A. Insulate suction lines. Liquid lines are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.

1. Do not install insulation until system testing has been completed and all leaks have been eliminated.

2. Insulation shall be Armaflex Ultra pipe insulation. Provide 1-inch insulation thickness. All seams and joints shall be adhered and sealed using Armaflex 520

adhesive. All fittings shall be insulated with same insulation thickness as straight pipe.

3. **Exposed refrigerant liquid and suction piping (located indoors and/or outdoors)**: shall be insulated and include two (2) coats of WB Armaflex Finish. In addition, liquid and suction lines shall be provided with aluminum jacketing; provide 0.016-inch Type 3105 on all exterior insulated piping. Fitting covers shall be 0.024-inch Type1100 aluminum. Jacketing and fitting covers shall be banded with 0.20-inch Type 3105, 1/2-inch-wide banding with 0.32-inch Type 5005 wing seals on 12-inch centers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION

A. Route piping parallel to building structure and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

E. Install pipe identification in accordance with Section 23 05 53 - Identification for HVAC Piping and Equipment.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Arrange refrigeration piping to return oil to compressor. Provide traps and loops in piping, and where necessary provide double risers. Slope horizontal piping 0.40 percent in direction of flow.

H. Provide access where valves and fittings are not exposed.

I. Flood refrigerant piping system with nitrogen when brazing.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

K. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 00.

L. Install valves with stems upright or horizontal, not inverted.

M. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.

N. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

O. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

P. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

Q. Provide electrical connection to solenoid valves.

R. Fully charge completed system with refrigerant after testing.

S. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

T. Install refrigerant piping in accordance with ASME B31.5.

U. Install piping in as short and direct arrangement as possible to minimize pressure drop.

V. Install piping with minimum number of joints using as few elbows and other fittings as possible.

W. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.

X. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.

Y. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.

Z. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

AA. Slope refrigerant piping as follows:

1. Install horizontal hot gas discharge piping with 1/2 inch per ten (10) feet downward slope away from the compressor.

2. Install horizontal suction lines with 1/2 inch per ten (10) feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.

3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.

4. Liquid runs

BB. Use fittings for all changes in direction and all branch connections.

CC. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

DD. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

EE. Conceal all pipe installation in walls, pipe chases, utility spaces, above ceilings, below grade floors, unless indicated to be exposed to view.

FF. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with one (1) inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

GG. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing or valves.

HH. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than six (6) inches shall be steel; pipe sleeves six (6) inches and larger shall be sheet metal.

II. Fire Barrier Penetrations: Seal pipe penetrations through fire rated wall, partitions, ceilings, and floors, maintain the fire rated integrity.

JJ. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

KK. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

LL. Install moisture / liquid indicators in liquid lines between filter / driers and thermostatic expansion valves and in liquid line to receiver.

1. Install moisture / liquid indicators in lines larger than 2-1/8-inch OD, using a bypass line.

MM. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.

NN. Install flexible connectors at the inlet and discharge connection of compressors.

3.3 INSTALLATION - REFRIGERANT SPECIALTIES

A. Refrigerant Liquid Indicators:

1. Install line size liquid indicators in main liquid line downstream of condenser.

2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.

3. Install line size liquid indicators downstream of liquid solenoid valves.

4. Install liquid indicator on leaving side of filter-driers.

B. Refrigerant Valves:

1. Install service valves on compressor suction and discharge.

2. Install gage taps at compressor inlet and outlet.

3. Install gage taps at hot gas bypass regulators, inlet, and outlet.

4. Install check valves on compressor discharge.

5. Install check valves on condenser liquid lines on multiple condenser systems.

6. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.

C. Strainers:

1. Install line size strainer upstream of each automatic valve.

2. Where multiple expansion valves with integral strainers are used, install single main liquid-line strainer.

3. On steel piping systems, install strainer in suction line.

4. Install shut-off valves on each side of strainer.

D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.

E. Filter-Dryers:

1. Install permanent filter-dryers in low temperature systems.

2. Install permanent filter-dryer in systems containing hermetic compressors.

3. Install replaceable cartridge filter-dryer vertically in liquid line adjacent to receivers.

4. Install replaceable cartridge filter-dryer upstream of each solenoid valve.

F. Solenoid Valves:

1. Install in liquid line of systems operating with single pump-out or pump-down compressor control.

2. Install in liquid line of single or multiple evaporator systems.

3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

3.4 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Comply with the procedures contained in the AWS: Brazing Manual".

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.

2. CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do not apply heat near the bulb of the expansion valve.

B. Pressurize the pipe and fittings during brazing with nitrogen to prevent formation of harmful oxides.

C. Heat joints using-acetylene torch. Heat to proper and uniform brazing temperature.

3.5 VALVE INSTALLTIONS - GENERAL

A. General: Install refrigerant valves in accordance with manufacturer's instructions.

B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.

C. Install a full sized, 3-valve bypass around each drier.

D. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.

1. Coordinate electrical requirements and connections.

E. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.

1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.

2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.

3. Secure the bulb straps. Do not mount build in a trap or at the bottom of the line.

4. Where external equalizer lines are required make the connection where it clearly reflect the pressure existing in the suction line at the bulb location.

F. Install pressure regulating and relieving valves required by ASHRAE Standard 15.

3.6 EQUIPMENT CONNECTIONS

A. Install piping adjacent to machine to allow servicing and maintenance.

3.7 FIELD QUALITY CONTROL

A. Install, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI.

B. Repair leaking joints using new materials and retest for leaks.

3.8 CLEANING

A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedures:

1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.

2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.

3. Draw a clean, lintless cloth saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint.

4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.9 ADJUSTING AND CLEANING

A. Verify actual evaporator applications and operating conditions and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.10 SYSTEM CHARGING

A. Charge system using the following procedure:

1. Install core in filter dryer after leak test but before evacuation.

2. Evacuate entire refrigerant system with a vacuum pump to 500 microns. When vacuum holds for a minimum of 24 hours, system is ready for charging.

3. During excavation, apply heat to pockets, elbows, and low spots in piping.

4. Break vacuum with refrigerant gas, allow pressure to build up to 2 psig.

5. Charge system with a new filter-dryer core in charging line.

B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, trouble shooting, servicing, and preventive maintenance of refrigerant piping valves and refrigerant piping specialties.

C. Review data in Operating and Maintenance Manuals.

D. Schedule training with Owner with at least seven (7) days advance notice.

END OF SECTION 23 23 00

SECTION 23 25 13 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

B. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

C. The Common Work Results for HVAC, Section 23 05 00, are included as a part of this Section as though written in full in this document.

1.3 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.4 DESCRIPTION OF WORK

A. Work Included: Perform water analysis and provide all water treatment products, holding reservoirs, equipment and labor for testing, cleaning, flushing and dispensing products to control water quality for each system specified hereinafter as follows:

1. Chilled Water Systems
2. Heating Water Systems

B. Chemicals: Provide, at no additional cost to the Owner, all chemicals required for operating and testing all water treatment systems prior to and for three months after acceptance by the Owner.

C. Instructions: Provide operating and maintenance instructions for each water treatment system; include one set in each Owner's Manual and deliver one set to Owner's operating personnel.

D. Testing Equipment and Reagents: Furnish suitable water treatment equipment for each system, complete with apparatus and reagents necessary for operation prior to and for three months after acceptance by the Owner.

E. Service Representative: Furnish the services of a qualified service representative to instruct Owner's operating personnel in proper operation and maintenance of water treatment equipment, systems and tests required. Service representative shall return to the site bi-weekly during first 2 months of operation and monthly during the remainder of the guarantee period. At such time, service representative shall check and adjust water treatment system operation, check efficiency of chemicals and chemical applications, and instruct and advise operating personnel.

F. Replacement and Rework: Replace defective or nonconforming materials and equipment with new materials and equipment at no additional cost to the Owner for 1 year after successful start-up of the system. All warranty work shall be FOB as installed at the project site.

1. Guarantee: Provide system produced by manufacturer who is willing to execute the required guarantee.

2. Agreement to Maintain: Provide system produced by manufacturer who is willing to execute (with the Owner) the required agreement for continued maintenance of the system.

1.5 QUALITY ASSURANCE

A. Qualifications: The Contractor for work under this Section shall have:

1. Research and development facilities.

2. Regional laboratories capable of making water analysis.

3. A service department and qualified technical service representative located within a reasonable distance of the project site.

4. Service representatives who are Registered Engineers of factory-certified technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.

B. Packaging and Labeling: Supply water treatment chemicals in metal drums, fiber drums with plastic liners, or plastic lined "liqui-paks" as best suited to the materials. Paper bags or unlined cardboard cartons will not be acceptable. Use only chemicals in domestic water systems, all coincides regardless of where used, which are registered with the U.S. Department of Agriculture (USDA) or the U.S. Environmental Protection Agency (EPA) and which are labeled as required by law.

C. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters Laboratories (UL) and which comply with National Electrical Manufacturers' Association (NEMA) standards.

D. Chemical Standards: Provide chemical products acceptable under state and local pollution control or other governing regulations.

1.6 SUBMITTALS

A. Test reports: Submit test reports certified by an officer of the firm, on water treatment company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test.

B. Shop Drawings: Submit shop drawings for each water treatment system. Show wiring, piping, and tubing sizes, fittings, accessories, valves and connections.

C. Guarantee: Submit written guarantee signed by the Manufacturer and countersigned by the Installer and Contractor, agreeing to adjust or replace the chemicals in the systems as required achieving the required performance, during a 1-year period following the final start-up or the continued operation of the chillers.

D. Agreement to Maintain: Prior to the time of final acceptance, the Manufacturer of the chilled water treating system shall submit four copies of an "Agreement for Continued Service and the Owner's possible acceptance." Offer terms and conditions for furnishings chemicals and providing continued testing and equipment for a 1-year period with option for renewal of the Agreement by Owner.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Worth Hydrochem of Houston.

2.2 GENERAL

A. Water Analysis: Determine which chemicals to use from the results of a water sample analysis taken from the building site by the system manufacturer. Provide ingredients necessary to achieve the desired water conditions.

B. **Pre-Treatment: For Flushing and Cleaning of Hydronic Piping, refer to specification section 23 25 19. Flushing and Cleaning of Hydronic Piping shall be performed by PurgeRite.**

C. Pre-Treatment: For new construction and/or renovations to existing Hydronic systems treat chilled and heating water piping systems with chemicals to remove and permit flushing of mill scale, oil, grease, and other foreign matter. Chemicals shall be equal to Nalco 2578 prepping compound. A school district supervisor is to be present to observe cleaning of chilled and heating water piping systems. SYSTEMS SHALL NOT BE STARTED UP UNTIL THE PIPING HAS BEEN CLEANED.

CLEANING OF CHILLED AND HEATING WATER PIPING SYSTEMS:

1. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the system 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.

2. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. 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.

3. Phase One: initial flushing of system. Remove loose dirt, mill scale, weld heads, 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.

4. 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.

5. Dispose of water in approved manner.

6. Phase Two: Cleaning of piping system. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), welding and soldering flux, and Mill varnish, piping components, rust (iron oxide) and other deleterious substances not removed by initial flushing. Chemical shall be approved equivalent to Nalco 2578 prepping compound. Insert anti-foam compound, as necessary. Circulate for 48 hours or as recommended by the manufacturer. Dispose of water in an approved manner. Flush system and

replace with clean water. Verify compatibility of chemicals used with existing chemical treatment program on remodel projects. For aluminum heat exchangers within condensing boiler, maintain pH less than 8.5, per manufacturer's recommendations.

7. Phase Three: Final flushing and rinsing 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.

8. Submit status report upon completion of each phase of work on each system.

9. Special requirements, if any, are specified in the sections on each type of piping.

D. FDA and USDA Approval: use only FDA and USDA-approved products in system with direct connection to domestic water systems.

E. Governing Laws: Ensure that neither products, waste, blow-down nor other effluents violate local, state, EPA, or other agency regulations in effect in the project area.

2.3 CHILLED AND HEATING WATER SYSTEMS

A. Chemicals: Provide water treatment products which contain inhibitors that perform the following:

1. Form a protective film to prevent corrosion and scale formation to maintain iron levels between 0.0 and 0.5 as Fe.

2. Scavenge oxygen and protect against scale

3. Remain stable throughout operating temperature range

4. Are compatible with pump seals and other elements in the system.

5. For aluminum condensing boilers, molybate at 10 to 25 ppm and maintain pH limit below 8.5; refer to boiler manufacturer's recommendation.

6. Chilled Water Loop: The inhibitor shall be a boron-nitrate scale inhibitor compound at 650 to 750 ppm as NO_2 (Nitrite); pH of 9.5 to 10.5; and to maintain Fe (Iron) levels between 0.0 and 0.5 ppm.

7. Heating Water Loop: The inhibitor shall be a boron-nitrate scale inhibitor compound at 750 to 1,000 ppm as NO_2 (Nitrite); pH of 9.5 to 10.5; and to maintain Fe (Iron) levels between 0.0 and 0.5 ppm.

B. Equipment: Provide a bypass feeder with a 5-gallon capacity. The feeder shall be constructed of 10-gauge steel and impervious to the products dispensed. Tank heads shall be a minimum of 9-gauge steel and shall be rated at 300 psi and to 200°F. Chemical feeder shall have inlet and outlet drain valves with full bottom drain. The tank shall have a wide mouth, 3-1/2" opening so that chemical addition can be performed without the need of a funnel. The bypass feeder shall have a continuous threaded closure requiring 2-1/2 turns to close and seal. Closures rated less than 300 psi shall not be considered equal.

The cap shall be constructed of cast iron with an epoxy-coated underside to prevent corrosion and shall use a square ring gasket seal. The ring gasket shall not be glued or

restrained from movement. Closures using “o” rings or gaskets which are glued or restrained from free movement by snap rings shall not be considered equal.

Provide bypass feeder with legs to elevate the feeder off of the floor. The legs shall have holes to allow mounting to anchor bolts.

The bypass feeder shall be provided with a 5-micron filter bag fully supported by a stainless-steel filter basket for simultaneous side stream filtering.

1. Acceptable Manufacturer: Neptune, model FTF-5DB.

C. Test Kit: Provide test kit and reagents for determining proper water conditions.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS PREPARATION:

A. General: After piping systems are erected and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and in the concentration recommended by the water treatment manufacturer for this portion of the work.

B. Testing: Perform test procedures and submit a written report of test conditions and results to the Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

3.2 FLUSHING:

A. Drain preparation and boil out products from the systems. Flush with clean water until system tests prove systems are free of preparation and boil out products and other contaminants prior to administering system water treatment as specified hereinbefore.

3.3 CHILLED AND HEATING WATER SYSTEM:

A. Treatment: Treat initial water charge to chilled water loop at 650-750 ppm as NO_2 and heating water loop at 750 to 1000 as NO_2 water systems, after system has been flushed and prepped, to achieve a water quality as specified.

B. Start-up Procedures: During chilled and heating water system start-up, operate chilled and heating water treating systems (after charging with specified chemicals) to maintain the required steady-state characteristics of cooling and heating water. Demonstrate system operation to Owner's operating personnel.

C. Reports: Prepare certified test report for each required water performance characteristic. Comply with the following ASTM standard, where applicable:

1. D 859 - Tests for Silica in Water and Water Waste

2. D 1067 - Tests for Acidity or Alkalinity of Water

3. D 1068 - Tests for Iron in Water and Wastewater

4. D 1126 - Tests for Hardness in Water

5.	D	1128	-	Tests for Identification of Types of Microorganisms and Microscopic Matter in Water and Wastewater
6.	D	3370	-	Sampling Water

D. Water Chemistry: Where water chemistry substantiates that pH is not necessary, chemical fee shall be based on water makeup qualities. Water analysis shall be based on the full parameters of operation, and all possible water supplies. Total hardness and "M" alkalinity of the makeup water will be the determining factor along with the technical limitations of the inhibitors.

3.4 PERSONNEL TRAINING:

A. Operator Training: Train Owner's personnel in use and operation of heating water, chilled water treating systems including preparation of chemical solution reservoir. A Program Administration Manual shall be furnished encompassing all systems in this section of the Specifications.

END OF SECTION 23 25 13

SECTION 23 25 19 – FLUSHING AND CLEANING OF HYDRONIC PIPING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Common Work Results for HVAC, Section 23 05 00, are included as a part of this Section as though written in full in this document.

1.3 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries.

1.4 DESCRIPTION OF WORK

A. Work Included: Perform water analysis and provide all water cleaning products, holding reservoirs, equipment and labor for cleaning, and flushing to control water quality for each system.

B. Testing Equipment and Reagents: Furnish suitable water flushing and cleaning equipment for each system, complete with apparatus and reagents necessary.

1.5 QUALITY ASSURANCE

A. Qualifications: The Contractor for work under this Section shall have:

1. A service department and qualified technical service representative located within a reasonable distance of the project site.

1.6 SUBMITTALS

A. Test reports: Submit test reports certified by an officer of the firm on company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test.

PART 2 – PRODUCTS

2.1 PROFESSIONAL FLUSHING AND CLEANING SERVICES PERFORMED BY:

A. PurgeRite, a third-party flushing company will be used for flushing and cleaning of the HVAC related piping.

Website:
www.purgerite.com

Email:
sales@purgerite.com

Phone:
936-344-6210.
Address:
13805 N. Highway 75, Suite B
Willis, TX 77378

2.2 GENERAL

A. Pre-Treatment: For new construction and/or renovations to existing hydronic systems, flush and clean all hydronic piping systems to remove and permit flushing of mill scale, oil, grease and other foreign matter. A school district supervisor is to be present to observe cleaning of hydronic piping systems. Systems shall not be started up until the piping has been cleaned.

2.3 FLUSHING AND CLEANING OF STEEL PIPING SYSTEM:

A. After the mechanical contractor has tested the piping, it is to be flushed and cleaned for service. Provide a complete water flushing and cleaning of the closed loop chilled and hot water systems as specified herein. Systems must be commissioned as clean and meet water treatment specifications.

B. All chilled and hot water piping and related equipment shall be thoroughly flushed out with pre- cleaning chemicals designed to remove deposits such as pipe dope, oils, loose rust, mill scale and other extraneous materials. Recommended dosages of pre-cleaner chemical products shall be furnished by water treatment supplier, added and circulated throughout the water systems. The water system shall then be diluted and final flushed thoroughly until no foreign matter is observed and total alkalinity of the water is equal to or better that that of the make-up water.

C. All temporary connections required for flushing, cleaning, purging, and circulating shall be included. Provide suitable pipe bypasses at each coil and heat exchanger during the flushing and cleaning operation.

D. Self-contained flush unit requirements will contain a pump or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. Pump curve will be submitted along with other important documentation for the related equipment on the unit. This will include, at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture. All operators will comply with all safety regulations of the project site. The flushing operation will be manned continuously during the flushing process.

E. Flushing Procedure Guidelines:

1. Pre-flush: Bypass loops should be installed in front of any strainers and control valves at all equipment components. Coordinate with PurgeRite for proper sizing and placement of bypasses and flush ports.

2. Install temporary strainer elements in front of pumps, tanks, solenoid valves, control valves, and other equipment where permanent strainers are not indicated that are not bypassed. Keep these strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow-off valve. Strainers should be removed when a self-contained flush unit is used in conjunction with on board filtration.

3. Flush ports should be identified along with the type of high-pressure hose or piping that will be used to connect to the system. The water source should be identified and

must be adequate to fill and make up water in a timely manner to the system during the flush process. A water dump location should be identified which as well is usually the sanitary.

F. Clear Water Flush

1. Fill the piping system with clean potable water. The first flush is a clear- water flush intended to circulate water through the system and force loose debris to low point drains and flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 -7 ft. /sec throughout. Filtration should be at minimum, 50 microns. This flush shall continue until the system water is comparable to the make-up water. Iron content should be under 2.0 ppm.

G. Cleaning & Passivation

1. The second flush cycle is a combined flushing cycle where cleaning and passivation chemicals are introduced into the system to clean the oils and treat the inside wall of the piping system. This process will be monitored by the chemical treatment company to meet the chemical specifications of the water. The cleaning velocity should be between 3 to 5 ft. /sec throughout, and the circulation time will be based on the chemical testing, but will be at minimum, 24 hours.

H. Final Clear Water Flush

1. The system will be continuously flushed while discharging chemicals into the sanitary system as approved locally. As the existing treated water is being discharged, a freshwater make-up source will be utilized to ensure air is not introduced into the system. Continue to drain the system while adding domestic water to dilute the treated water. The chemical treatment company will monitor the outgoing water composition and compare the composition with the incoming water. Flush with fresh water until the conductivity is reduced to that of the make-up water and iron meets specifications. The final system water should be approved by the chemical treatment company. Filtration should be 5 microns.

I. Final Chemical Fill

1. Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system. Once the system is filled with the final chemicals it is important the water not be left stagnant.

2. Verify satisfactory completion of clean piping and a final flushing and chemical treatment report should be submitted by field personnel. The report should include at minimum, project name, date, location, parties involved, type of pipes treated, scope summary, flows, durations, and other relevant information.

3. Cleaning chemicals, procedure, water testing, reporting, and consultation must be provided by a qualified water treatment company specializing in this type of work.

2.4 FLUSHING AND CLEANING OF PEX, POLYPROPYLENE, OR HDPE PIPING SYSTEMS:

A. After the mechanical contractor has tested the piping, it is to be flushed and cleaned for service. Provide a complete water flushing and cleaning of the piping as specified herein. Systems must be commissioned as clean.

B. All temporary connections required for flushing, cleaning, purging, and circulating shall be included. Provide suitable pipe bypasses at any equipment or building during the flushing and cleaning operation.

C. Self-contained flush unit requirements should contain a pump or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. Pump curve will be submitted along with other important documentation for the related equipment on the unit. This will include at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture. All operators will comply with all safety regulations of the project site. The flushing operation will be manned continuously during the flushing process.

D. Flushing Procedure Guidelines

1. Pre- Flush:

Bypass loops should be installed at all equipment or building components. Strainers should be removed when a self-contained purge unit is used in conjunction with on board filtration. Flush ports should be identified along with the type of high-pressure hose or piping that will be used to connect to the system. The water source should be identified and must be adequate to fill and make up water in a timely manner to the system during the flush.

2. Clear Water Flush:

Fill the piping system with clean potable water. The first flush is a clear- water flush intended to circulate water through the system and force loose debris to low point drains and flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 – 7 ft. /sec throughout. Filtration should be at minimum, 5 microns. Minimum duration should be calculated using a formula of 1 hour per 1000' of linear pipe and until system water is comparable to make up water source. The minimum circulation time should be 1 hour regardless of the length.

3. Final Chemical Fill

Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system if required. Once the system is filled with the final chemicals it is important the water is not left stagnant and to mix chemicals.

Verify satisfactory completion of clean piping and a final flushing report will be submitted by field personnel. The report will include at minimum, project name, date, location, parties involved, type of pipes treated, scope summary, flows, durations, and other relevant information.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS PREPARATION:

A. General: After piping systems are erected and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and in the concentration recommended by the water treatment manufacturer for this portion of the work.

B. Testing: Perform test procedures and submit a written final report (at each phase if applicable) of test conditions and results to the Contractor and Consulting Engineer. If

test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

END OF SECTION 23 25 19

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and Flat Oval ducts and fittings.
3. Double-wall rectangular ducts and fittings.
4. Double-wall round and Flat Oval ducts and fittings.
5. Double-wall flat oval / round / rectangular outdoor ductwork.
6. Insulated Flexible Ducts
7. Sheet metal materials.
8. Sealants and gaskets.
9. Duct coating requirement for Natatoriums.
10. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

3. Division 23 Section “Duct Insulation” for internal duct liner.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: For each type of the following products:

1. Adhesives.
2. Sealants and gaskets.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Factory- and shop-fabricated ducts and fittings.

3. ¼" = 1'-0" Scale Duct layout drawings indicating sizes, configuration, liner material, static-pressure classes, and bottom of duct elevations. Duct shop drawings shall be superimposed on the architectural backgrounds with the reflected ceiling plans.

4. Dimensions of main duct runs from building grid lines.

5. Fittings.

6. Reinforcement and spacing.

7. Seam and joint construction.

8. Penetrations through fire-rated and other partitions.

9. Equipment installation based on equipment being used on Project.

10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.

2. Suspended ceiling components.

3. Structural members to which duct will be attached.

4. Size and location of initial access modules for acoustical tile.

5. Penetrations of smoke barriers and fire-rated construction.

6. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Open ends of ductwork shall be factory shrink wrapped air and watertight before shipment to jobsite.

B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
2. Gurry Mechanical L.P.
3. Letsos Company
4. Mason Road Sheet Metal Inc.
5. McCorvey Sheet Metal Works
6. Titan Metals
7. Telkin Sheetmetal, Inc.
8. Tomball Sheet Metal Co.
9. MLN
10. Walsh & Albert
11. Grant Sheet Metal
12. Tennapel Sheet Metal
13. McGill AirFlow LLC.
14. Texas Duct Systems
15. South Texas Sheet Metal
16. Texas Air Duct Systems
17. SEMCO Incorporated
18. Lindab Inc.

B. Fabricate ducts with indicated dimensions for the inner duct.

C. Sheet Metal Connectors, Inc

D. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

G. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Envirotech Mechanical Systems
   2. Gurry Mechanical L.P.
   3. Letsos Company
   4. Mason Road Sheet Metal Inc.
   5. McCorvey Sheet Metal Works
   6. Telkin Sheetmetal, Inc.
   7. Titan Metals
   8. Tomball Sheet Metal Co.
   9. MLN
   10. Walsh & Albert
   11. Grant Sheet Metal
   12. Tennapel Sheet Metal
   13. McGill AirFlow LLC.
   14. Texas Duct Systems
   15. South Texas Sheet Metal
   16. Texas Air Duct Systems
   17. SEMCO Incorporated
   18. Lindab Inc.

B. Fabricate ducts with indicated dimensions for the inner duct.

C. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

D. Triple-Rib shall be acceptable for single wall spiral lockseam ducts: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

   2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
2. Gurry Mechanical L.P.
3. Letsos Company
4. Mason Road Sheet Metal Inc.
5. McCorvey Sheet Metal Works
6. Telkin Sheetmetal, Inc.
7. Titan Metals
8. Tomball Sheet Metal Co.
9. MLN
10. Walsh & Albert
11. Grant Sheet Metal
12. Tennapel Sheet Metal
13. McGill AirFlow LLC.
14. Texas Duct Systems
15. South Texas Sheet Metal
16. Texas Air Duct Systems
17. SEMCO Incorporated
18. Lindab Inc.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: K = 0.23 at 75 deg. F mean temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

3. Coat insulation with antimicrobial coating.

4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: K = 0.23 at 75 deg. F mean temperature.

H. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
2. Gurry Mechanical L.P.
3. Letsos Company
4. Mason Road Sheet Metal Inc.
5. McCorvey Sheet Metal Works
6. Telkin Sheetmetal, Inc.
7. Titan Metals
8. Tomball Sheet Metal Co.
9. MLN
10. Walsh & Albert
11. Grant Sheet Metal
12. Tennapel Sheet Metal
13. McGill AirFlow LLC.
14. Texas Duct Systems
15. South Texas Sheet Metal
16. Texas Air Duct Systems
17. SEMCO Incorporated
18. Lindab Inc.

B. Fabricate ducts with indicated dimensions for the inner duct.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

D. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Transverse Joints in Ducts Larger Than 60 Inches Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

    b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: K = 0.23 at 75 deg F mean temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

3. Coat insulation with antimicrobial coating.

4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: K = 0.23 at 75 deg F mean temperature.

2.5 DOUBLE-WALL FLAT OVAL / ROUND / RECTANGULAR OUTDOOR DUCTWORK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
2. Gurry Mechanical L.P.

3. Letsos Company
4. Mason Road Sheet Metal Inc.
5. McCorvey Sheet Metal Works
6. Telkin Sheetmetal, Inc.
7. Titan Metals
8. Tomball Sheet Metal Co.
9. MLN
10. Walsh & Albert
11. Grant Sheet Metal
12. Tennapel Sheet Metal
13. McGill AirFlow LLC.
14. Texas Duct Systems
15. South Texas Sheet Metal
16. Texas Air Duct Systems
17. SEMCO Incorporated
18. Lindab Inc.
19. Linx.

B. Fabricate ducts with indicated dimensions for the inner duct.

C. Material:

1. Outer Duct: 18-gauge epoxy coated galvanized duct.

2. Material thickness constructed in accordance with latest SMACNA's HVAC Duct Construction Standards.

D. Inner Duct: 20 gauge perforated galvanized duct.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B.

1. Minimum 2" insulation and R-value of 8 at 75°F mean ambient temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

3. Coat insulation with antimicrobial coating.

F. Exterior Coating / Finish.

1. Epoxy coated exterior duct.

2. Average thickness of 4 mils to meet or exceed 3,000-hour salt spray test per ASTM B17-97.

3. Coordinate color with the architect and the owner.

2.6 INSULATED FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Thermaflex Type M-KE.
b. Atco

B. Product Description: UL 181, Class 1, CPE fabric attached to helical wound spring galvanized steel wire; fiberglass insulation; aluminized vapor barrier film.

a. Pressure Rating: six (6) inches wg positive and four (4) inches wg negative.
b. Maximum Velocity: 4,000 fpm.
c. Temperature Range: -20 degrees Fahrenheit to 210 degrees Fahrenheit.
d. Thermal Resistance: Minimum R-6 installed.
e. Maximum flexible duct length shall not exceed 5’-0”.

C. Provide Flexible Duct Elbow Supports at each diffuser. Refer to “23 33 00 Air Duct Accessories”; 2.10 Flexible Duct Elbow Supports.

2.7 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches.

2.8 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).

7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 DUCT COATING REQUIREMENTS FOR NATATORIUMS

A. General Coating Requirements: For any Metal Supply, Return, Outside Air, and Mixing Plenum duct including turning vanes and access doors; all surfaces shall be completely coated externally and internally prior to installation of insulation.

1. Inner liner and duct work: Amercoat PSX® 700 ETC. or prior approved equal.

a. Application Procedure: Adhere to all application instructions, precautions, conditions, and limitation to obtain the maximum performance. Contact PPG representative for manufacturer’s recommendations.

b. Surface Preparation: Prior to coating, primed surface must be clean, dry, undamaged, and free of all contaminants. Remove all loose rust, dirt, grease, oil, etc. or any other contaminants.

c. Environmental Conditions: Surface temperatures must be at least 5°F above dewpoint to prevent condensation during application and initial dry through.

1. Air Temperature: 40°F - 120°F

2. Surface Temperature: 40°F - 120°F

3. Relative Humidity: 40% minimum

2.10 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Duct straps shall be wrapped from the top cord of joists; straps wrapped from the bottom chord will not be accepted.

E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

I. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Ductwork installed on the roof shall be installed and supported such that the roof may be maintained / repaired without the need to disassemble any ductwork.

3.2 REQUIREMENTS FOR DRYER EXHAUST DUCTS

A. Dryer exhaust ducts for clothes dryers shall be smooth, rigid galvanized duct and shall terminate on the outside of the building and shall be equipped with a backdraft damper. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent, or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums. Provide weather resistant stainless-steel wall cap at duct / wall penetration and a minimum 8” relief hood at roof penetration with roof curb, flashing and counter flashing.

3.3 REQUIREMENTS OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 ADDITIONAL REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.5 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. For fastening of sheet metal support straps on each side of the duct, provide (2) two sheet metal screws on the side of the duct and (1) one on the bottom of the duct for a total of (6) six sheet metal screws for maximum fastening of strap to sheet metal duct.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

A. Paint all outdoor ductwork, exposed ductwork and exterior of metal ducts that are visible through cloud ceilings, registers, and grilles, etc. and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer; refer to paint manufacturer's instructions to prevent peeling. Coordinate final paint color with architect. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 DUCT STORAGE / CLEANING

A. Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic with no exposed ends. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not "dried-in". If this is required, the entire lengths of duct shall be covered in plastic for protections. The Owner / Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing NADCA certified Contractor.

B. The working area shall be clean, dry and the ductwork protected from dust. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

3.10 FIELD QUALITY CONTROL – DUCT LEAKAGE TEST (REQUIRED)

A. Perform tests and inspections. Owner and Engineer shall be present for duct pressure testing.

B. Leakage test to be witnessed by Owner and Engineer prior to being insulated.

C. Leakage Tests:

1. Submit a test report for each test.

2. Test the following systems:

   a. Supply, Return, Exhaust and Outside air ductwork.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

4. Test for leaks before applying external insulation.

5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Provide Owner and Engineer (7) seven days advanced notice for testing.

3.11 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. All exposed ducts in spaces such as but not limited to: Gymnasiums, Natatoriums, Cafeteria's, Libraries, etc.: Double wall insulated round ductwork.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Split-DX System Air Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 1-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Constant-Volume Air-Handling and Rooftop Units:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round: 6.

3. Ducts Connected to Variable-Air-Volume Air-Handling and Rooftop Units:

a. Pressure Class: Positive 4-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round: 3.

C. Return and Outside Air Ducts:

1. Ducts Connected to Fan Coil Units, Split-DX System Air Units Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 1-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Air-Handling and Rooftop Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round: 6.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 1-inch wg.
b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.

c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round: 6.

2. Ducts Connected to Air-Handling and Rooftop Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round: 6.

3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

a. Exposed to View: 18-gauge Type 304, stainless-steel sheet, No. 4 finish.
b. Concealed: 16-gauge Carbon-steel sheet.
c. Continuously welded seams and joints
d. Pressure Class: Positive or negative 2-inch wg.
e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
f. SMACNA Leakage Class: 3.

4. Ducts Connected to Dishwasher Hoods:

a. 18-gauge Type 304, stainless-steel sheet.
b. Exposed to View: No. 4 finish.
c. Concealed: No. 2D finish.
d. Continuously welded seams and joints
e. Pressure Class: Positive or negative 2-inch wg.
f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
g. SMACNA Leakage Class: 3.

5. Ducts Connected to Shower Return air grilles:

a. 18-gauge Type 304, stainless-steel sheet.
b. Exposed to View: No. 4 finish.
c. Concealed: No. 2D finish.
d. Continuously welded seams and joints
e. Pressure Class: Positive or negative 2-inch wg.
f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
g. SMACNA Leakage Class: 3.

6. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:

a. Type 316, stainless-steel sheet.

1. Exposed to View: No. 4 finish.
2. Concealed: No. 2D finish.

b. Continuously welded seams and joints
c. Pressure Class: Positive or negative 3-inch wg.
d. Minimum SMACNA Seal Class: A.
e. SMACNA Leakage Class: 3.

7. Ducts Connected to Chlorine and Acid Rooms (ASHRAE 62.1, Class 3 and 4) Air:

a. Type 316, stainless-steel sheet.

1. Exposed to View: No. 4 finish.
2. Concealed: No. 2D finish.

b. Continuously welded seams and joints
c. Pressure Class: Positive or negative 3-inch wg.
d. Minimum SMACNA Seal Class: A.
e. SMACNA Leakage Class: 3.

8. Ducts Connected to Fans Exhausting Welding Fumes (ASHRAE 62.1, Class 3 and 4) Air:

a. Type 316, stainless-steel sheet.

1. Exposed to View: No. 4 finish.
2. Concealed: No. 2D finish.

b. Continuously welded seams and joints
c. Pressure Class: Positive or negative 3-inch wg.
d. Minimum SMACNA Seal Class: A.
e. SMACNA Leakage Class: 3.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.

b. Not Exposed to Airstream: Match duct material.

3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1,

"Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1. Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1,000 fpm or Lower: 90-degree tap.
b. Velocity 1,000 to 1,500 fpm: Conical tap.
c. Velocity 1,500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Back-draft dampers.
2. Combination fire-and-smoke dampers.
3. Duct access doors.
4. Fire dampers.
5. Smoke dampers.
6. Volume control dampers.
7. Flexible duct connections
8. Duct Taps
9. Duct test holes
10. Flexible duct elbow supports

B. Related Sections:

1. Section 23 31 00 - HVAC Duct and Casings: Requirements for duct construction and pressure classifications.

1.3 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Shop Drawings: Indicate shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.

C. Product Data: Submit data for shop fabricated assemblies including fire dampers including locations and ratings, smoke dampers including locations and ratings, backdraft dampers, flexible duct connections, volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Submit for Fire, Smoke and Combination Fire/Smoke Dampers.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

1.6 COORDINATION

A. Coordinate Work where appropriate with building control Work.

B. Coordinate fire alarm wiring requirements with Division 26.

1.7 WARRANTY

A. Furnish five (5) year manufacturer warranty for duct accessories.

1.8 EXTRA MATERIALS

A. Furnish two (2) of each size and type of fusible link for fire rated dampers.

PART 2 - PRODUCTS

2.1 BACK-DRAFT DAMPERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Arrow United Industries
2. American Warming and Ventilating
3. Ruskin
4. Air Balance
5. NCA
6. Pottorff
7. Greenheck

B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6-inch width, center pivoted, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Cesco
2. NCA
3. Ruskin
4. Nailor
5. Pottorff
6. Greenheck

B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S. Dampers shall be Leakage Class 1. Damper shall include a factory installed sleeve.

C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage, and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.

D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Locate damper operator on exterior of sleeve and link to damper operating shaft.

E. Temperature rating: 250°F.

F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure.

G. Coordinate fire alarm control wiring with Division 26.

H. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure, stainless steel springs with locking devices to maintain positive closure for units mounted horizontally.

J. Electric Fuse Link: Heat actuated, quick detecting to release at 165 degrees Fahrenheit, UL listed and labeled. Controlled closing and locking of damper in 7-15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable. Manual reset at damper.

2.3 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1-inch-thick insulation with sheet metal cover.

1. Less Than 12 inches square, secure with sash locks.

2. Up to 18 inches Square: Furnish two hinges and two (2) sash locks.

3. Up to 24 x 48 inches: Three hinges and two compression latches with outside handles.

4. Larger Sizes: Furnish additional hinge.

5. Access panels with sheet metal screw fasteners are not acceptable.

2.4 FIRE DAMPERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Cesco
2. NCA
3. Ruskin
4. Nailor
5. Pottorff
6. Greenheck

B. Fabricate in accordance with NFPA 90A and UL 555, and manufacturer's condition of listing. Permanently mark dampers for use in dynamic systems.

C. Ceiling Fire Dampers: Galvanized steel, 24 gage frame and 24 gage blades with UL classified insulation if required. Provide with radiation blanket.

D. Curtain Type Dampers: 20 gage Galvanized steel frame with interlocking 24 gage galvanized steel blades. Furnish stainless steel closure springs and latches for horizontal installations and closure under airflow conditions. Configure with blades out of air stream.

E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, 1/8 x 1/2-inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

F. Fusible Links: UL 33, separate at 165 degrees Fahrenheit.

G. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

2.5 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Cesco
2. NCA
3. Ruskin
4. Nailor
5. Pottorff
6. Greenheck

B. Fabricate in accordance with UL 555S, Leakage Class I.

C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish self-lubricating stainless-steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.

D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Actuator to be mounted internally or externally as required.

E. Temperature rating: 250°F.

F. Coordinate fire alarm control wiring with Division 26.

2.6 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.

B. Splitter Dampers:

1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal secured with continuous hinge or rod with end bearings.

3. Operator: Minimum 1/4-inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.

C. Single Blade Dampers: Fabricate for duct height up to 12”.

D. Multi-Blade Damper: Opposed blade interlocking type pattern for duct height 12” and greater. Assemble blades in galvanized frame channel with suitable hardware and linkage concealed in frame. Provide multiple section dampers for sizes larger than 48-inch x 72 inch. Provide jack shafting configuration and crossovers.

E. Damper Blades:

1. Provide 16-gauge galvanized steel center and edge grooved blade type where velocities do not exceed 1500 FPM.

2. Provide 14 gage galvanized steel. Roll formed airfoil blade type where velocities exceed 1500 FPM.

3. Maximum leakage shall be 8 CFM per square foot of damper area at four (4) inches wg pressure.

F. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or bronze bearings. Furnish closed end bearings on ducts having pressure classification over two (2) inches wg.

G. Quadrants:

1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers that do not have actuators.

2. On insulated ducts mount quadrant regulators on 2” standoff mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches furnish regulator at both ends.

4. Provide remote damper operators for concealed dampers. Operator shall utilize miter gears, worm gears and couplings or be cable operated. Coordinate operator trim and location with Architect / Engineer.

H. Actuators:

1. Maximum damper area per actuator shall be 24 square feet face area.

2. Actuators shall be two position or modulating spring return type.

3. Duct mounted dampers shall have actuators mounted outside of air stream.

4. Coordinate with Section 23 09 23 – Direct-Digital Control System for HVAC.

2.7 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.

2. Net Fabric Width: Approximately six (6) inches wide.

3. Metal: Three (3) inch wide, galvanized steel. Same gage as connecting duct.

4. Install flexible connections with a minimum of one (1) inch between metal edges.

5. Provide flexible duct connections at every duct connection to equipment.

C. Application:

1. Flexible duct connectors are not permitted on duct connections to internally isolated equipment. Internal isolation shall be in accordance with Section 230548.

2.8 DUCT TAPS

A. Provide 24-gauge galvanized steel conical fittings with integral balancing damper for duct taps serving single ceiling diffuser. Balancing damper shall consist of 24 gauge, 3/8” steel axel and nylon end bearings with 2” standoff quadrant mount.

B. Provide 24-gauge galvanized steel 45 degree, rectangular to round, side takeoff fitting with integral balancing damper when airflow is less than or equal to 20 percent of main duct airflow. Balancing damper shall consist of 24 gauge, 3/8” steel axel and nylon end bearings with 2” standoff quadrant mount.

C. Provide tee split with radius elbow when takeoff or branch duct airflow is greater than 20 percent of main duct. Square throat elbows are acceptable in areas of limited clearances. Provide splitter damper. Refer to Section 23 31 00 - HVAC Duct and Casings.

D. Provide volume damper at all takeoffs in constant volume systems and at all takeoffs downstream of terminal units in variable volume systems.

2.9 DUCT TEST HOLES

A. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

B. Coordinate test hole locations and requirements with TAB contractor. If additional test holes are required for TAB, contractor will provide at no additional cost.

2.10 FLEXIBLE DUCT ELBOW SUPPORTS

A. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6" – 16". Elbow supports shall be UL listed for use in return air plenum spaces.

B. Provide elbow supports at each diffuser connection.

C. Manufactured by Thermaflex – FlexFlow Elbow

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify rated walls are ready for fire damper installation.

B. Verify ducts and equipment is ready for accessories.

C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 REPORTS

A. Per NFPA 90A, all fire dampers, smoke dampers and fire/smoke dampers must be tested prior to occupancy and contractor shall provide written confirmation if the dampers are operating as required. Provide pass / fail report in excel spreadsheet. Include type of damper, damper manufacturer / model, actuator manufacturer / model, fusible link in the excel spreadsheet.

B. Contractor to provide as-built drawings of location of all fire, smoke and fire/smoke dampers with appropriate label that matches the installation.

C. Per NFPA 80, contractor shall test and inspect all dampers prior to one (1) year warranty period. All inspections, testing and maintenance of dampers must be documented, indicating the location of the damper, date(s) of inspection, name of inspector and deficiencies discovered. The document must have a space to indicate when and how the deficiencies were corrected. All documentation is expected to be maintained and made available for review by the AHJ.

D. After first year, test and inspection frequency must be every 4 years.

3.3 INSTALLATION.

A. Install in accordance with NFPA 90A and follow SMACNA HVAC Duct Construction Standards Metal and Flexible. Refer to Section 23 31 00 - HVAC Duct and Casings for duct construction and pressure class.

B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside if motorized dampers are not shown on plans.

C. Install duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and as indicated on Drawings. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Install minimum 8 x 8-inch size for hand access, 18 x 18-inch size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.

D. Install temporary duct test holes required for testing and balancing purposes. Cut or drill in ducts. Cap with neoprene plugs, threaded plugs, threaded or twist-on metal caps.

E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, and breakaway duct connections.

F. Install smoke dampers and combination fire and smoke dampers in accordance with NFPA 92A.

G. Install volume dampers at points on supply, return, outside air and exhaust systems where branches extend from larger ducts. For air systems with common return air plenum provide volume dampers in both outside air and return air ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.
3. Install stainless steel volume dampers in stainless steel ducts.
4. Install aluminum volume dampers in natatoriums.

3.4 DEMONSTRATION

A. Demonstrate re-setting of fire dampers, fire and smoke dampers and smoke dampers to Owner's representative.

END OF SECTION 23 33 00

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide complete, fully operational fans where indicated on Drawings.

B. Section Includes:

1. Upblast centrifugal roof fans
2. Inline Fans

C. Related Sections:

1. Section 23 31 00 - HVAC Duct and Casings - Ducts: Product requirements for hangers for placement by this section.

2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

3. Coordinate work in this Section with Division 7.

1.3 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.

C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics, and connection requirements.

D. Manufacturer's Installation Instructions: Submit fan manufacturer’s instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.

D. Balance Quality: Conform to AMCA 204.

1.6 WARRANTY

A. Furnish one (1) year manufacturer's warranty for fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.

1. Fan Belts: Two (2) sets for each belt-driven fan.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 UNIT IDENTIFACTION REQUIREMENTS

A. Furnish each fan with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Unit identification as indicated within Contract Documents.
- Serial Number.

- Model Number.
- Capacity (CFM) and static pressure (w.g.).
- Motor Horsepower.
- Fan RPM.
- Unit Power Supply: Volts / PH / Amps.
- Supply Fan Drive Type.
- Sales Order #.
- Date of unit manufactured.

PART 2 - PRODUCTS

2.1 UPBLAST CENTRIFUGAL ROOF FANS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Greenheck
2. Cook
3. Twin City

B. Fan shall be a spun aluminum, roof mounted, belt driven or direct drive, upblast centrifugal ventilator. Coordinate drive with fan schedule on drawings.

C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.

D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14-gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.

G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

H. Drives: Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

I. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.

J. Accessories:

1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch. Damper shall be epoxy coated.

2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.

3. Direct drive units shall be provided with motor speed control option.

4. Birdscreen: Stainless steel rigid wire to protect fan discharge from birds or small objects.

2.2 INLINE FANS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Greenheck
2. Cook
3. Twin City

B. Fan shall be a duct mounted, centrifugal, belt driven or direct drive, inline type supply or exhaust ventilator.

C. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.

D. Construction: The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components. Each fan shall bear a permanently affixed manufacturer’s nameplate containing the model number and individual serial number for future identification.

E. Coating: For fans serving Natatoriums or corrosive environments provide epoxy coating on all inside and outside surfaces including fan wheel and pulley.

F. Wheel: The fan wheels shall be centrifugal backward inclined, constructed o f aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.

G. Motor: Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase, and enclosure. Motor Pulleys shall be adjustable for system balancing.

H. Bearings: Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum catalogued operating speed.

I. Belts & Drives: Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

J. Accessories:

1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Three phase combination disconnect/starter shall be provided by Division 26.

2. Gravity actuated back-draft damper with adjustable counterweight. Damper shall be epoxy coated.

3. Direct drive units shall be provided with motor speed control option.

4. Companion Flanges: For inlet and outlet duct connections.

5. Fan Guards: 1/2 by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.

6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify roof curbs are installed, and dimensions are as shown on shop drawings.

3.2 INSTALLATION

A. Secure roof fans with cadmium plated steel lag screws to roof curb structure.

B. Install power ventilators level and plumb.

C. Install dampers in roof curb damper tray.

D. Provide hinged curb adapter to permit access to dampers and duct connection.

E. Install safety screen where inlet or outlet is exposed.

F. Provide sheaves required for final air balance.

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 CLEANING

A. Vacuum clean inside of fan cabinet.

3.4 DEMONSTRATION

A. Demonstrate fan operation and maintenance procedures.

3.5 PROTECTION OF FINISHED WORK

A. Do not operate fans until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 23 34 00

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single duct air terminal units
2. Series Fan-Powered Air Terminal Units

B. Related Sections:

1. Section 23 09 23 – Direct Digital Controls: Controls remote from unit.

2. Section 23 09 93 – Sequences of Operation for HVAC System.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.4 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.

1. Air terminal units.
2. Liners and adhesives.
3. Sealants and gaskets.

C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work within shop coordination drawings.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

3. Hangers and supports, including methods for duct and building attachment and vibration isolation.

D. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.

E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.

2. Size and location of initial access modules for acoustic tile.

3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

F. Field quality-control reports.

G. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in "Operation and Maintenance Data," include the following:

1. Instructions for resetting minimum and maximum air volumes.

2. Instructions for adjusting software set points.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Test and rate air terminal unit performance for air pressure drop, flow performance, and acoustical performance in accordance with ARI 880 and ARI 885. Attach ARI seal to each terminal unit.

C. All electrical components shall be UL Listed and installed in accordance with the National Electric Code. Electrical connections to terminal units shall be single point. The energy terminal shall be UL Listed as a complete assembly.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.6 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Filters shall be provided by air terminal unit manufacturer and not by the mechanical contractor.

1. Fan-Powered-Unit Filters: Furnish [one] 1 spare filter(s) for each filter installed.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.9 COORDINATION

A. Coordinate Work with Section 23 09 23 - Direct-Digital Control System for HVAC.

1.10 WARRANTY

A. Furnish one (1) year manufacturer warranty for air terminal units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Air Terminal Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Titus
2. Price
3. Metalaire
4. Krueger

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.

D. Casing: Minimum 22-gauge galvanized steel.

1. Casing Lining: Fiber free, 1/2-inch thick, engineered polyurethane foam, 1.5 lb. / cu. ft. insulation complying with NFPA 90A, UL 181 erosion requirements, UL 181 Mold Growth and Humidity, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Exposed fiberglass is not acceptable. The casing shall be designed for hanging by 10-gauge sheet metal hanger brackets for suspending unit with threaded rod.

2. Air Inlets: Round stub connections or oval connections for duct attachment.

3. Air Outlet: S-slip and drive connections.

4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Volume Damper: Heavy gauge galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.

2. Damper Position: Normally open.

F. Velocity Sensors: Multi-point array, center-averaging differential pressure, with velocity sensors in air inlets and air outlets. Sensors that deliver the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.

G. Actuators shall be capable of supplying at least 35 inches per pound of torque to the damper shaft and shall be mounted externally for service access.

H. Factory installed hydronic heating coils (where scheduled): Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

I. Factory installed Electric-Resistance Heating Coils (where scheduled): Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Provide 480v / 3ph / 60Hz 4W wye single point power connection.

2. Stage(s): Refer to schedule.

3. Access door interlocked non-fused disconnect switch.

4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)

5. Nickel chrome 80/20 heating elements.

6. Airflow switches for proof of airflow.

7. Fan interlock contacts.

8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).

9. Magnetic contactor for each step of control (for three-phase coils).

J. Factory-Mounted and Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source for terminal units with electric heat.

1. Control Transformer (Required only for terminal units with electric heat): Factory mounted for control voltage. Coordinate equipment voltage requirement with electrical plans.

2. Wiring Terminations: Coordinate required wiring diagrams with Building Automation System controls subcontractor.

3. The following equipment items are to be furnished by Specification Section 23 09 23 - Direct-Digital Controls and installed by air terminal unit manufacturer.

   a. Auto temperature control card (DDC).
   b. 24-volt damper actuator.

4. The following equipment items are to be furnished and installed by the air terminal unit manufacturer:

   a. Volume Control Damper.
   b. Multi-point flow sensor.
   c. Controller enclosure.
   d. Power transformer; required only for terminal units with electric heat. (Coordinate voltage with electrical plans).

K. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

L. Sound Ratings: Not to exceed 35 NC at one (1) inch static pressure. Sound performance shall be ARI certified.

1. Maximum discharge sound power level of 62 DB.
2. Maximum radiated sound power level of 70 DB.
3. DB level based on third octave band.

M. Temperature sensor provided, wired, and installed by Building Automation System Control Contractor: Refer to Section 23 09 23 – Direct Digital Controls.

N. For Sequence of Operation: Refer to Section 23 09 93.

2.2 SERIES FAN-POWERED AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Titus
2. Price
3. Metalaire
4. Krueger

B. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud for installation above a ceiling.

C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.

D. Casing: Minimum 20-gauge galvanized steel.

1. Casing Lining: Fiber free, 1/2-inch thick, engineered polyurethane foam, 1.5 lb. / cu. ft. insulation complying with NFPA 90A, UL 181 erosion requirements, UL 181 Mold Growth and Humidity, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Exposed fiberglass is not acceptable. The casing shall be designed for hanging by 10-gauge sheet metal hanger brackets for suspending unit with threaded rod.

2. Air Inlets: Round stub connections or oval connections for duct attachment.

3. Air Outlet: S-slip and drive connections.

4. Access: Removable top and bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections; with airtight gasket and quarter-turn latches.

5. Fan: Forward-curved centrifugal; direct-drive.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Volume Damper: Heavy gauge galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.

2. Damper Position: Normally open.

F. Velocity Sensors: Multi-point array, center-averaging differential pressure, with velocity sensors in cold- and hot-deck air inlets and air outlets. Sensors that deliver the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.

G. Motor:

1. Type: General Electric electronically commutated motor (ECM), variable speed dc brushless. Motor shall be complete and operated by a single-phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motor shall be directly coupled to the blower. Motor shall maintain a minimum of 70 percent efficiency over its entire operating range. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.

2. Fan-Motor Assembly Isolation: Rubber isolators.

3. Enclosure: Totally enclosed, air over.

4. Enclosure Materials: Rolled Steel.

5. Motor Bearings: Permanently lubricated ball bearings.

6. Unusual Service Conditions:

7. Efficiency: Premium efficient.

8. NEMA Design: NEMA MG-1.

9. Service Factor: 1.15.

10. Motor Speed: Infinitely adjustable, factory provided and mounted PWM controller for adjustable fan speed control. PWM controller shall be field adjustable with standard screwdriver. Fan CFM shall be pre-set at factory as shown on plans.

11. Electrical Characteristics:

    a. Horsepower: Refer to detail
    b. Volts: 277
    c. Phase: Single.
    d. Hz: 60.

H. Construction Filters for induced air inlet: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Material: Pleated cotton-polyester media having 90 percent arrestance and minimum MERV 8.

2. Thickness: 1 inch.

I. Factory manufactured and mounted Induced air inlet and discharge air attenuator section: steel sheet outer casing, sound absorbing fill material with coating, and inner casing of perforated sheet metal (Provide where scheduled).

1. Lining: Adhesive attached, 3/4-inch thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-

spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

J. Factory installed hydronic heating coils (where scheduled): Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

K. Factory installed Electric-Resistance Heating Coils (where scheduled): Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Provide 277v/ 480v / 3ph / 60Hz 4W wye single point power connection, factory pre-wired for 277v/1ph/60Hz connection to fan.

2. Stage(s): Refer to schedule.

3. Access door interlocked disconnect switch.

4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)

5. Nickel chrome 80/20 heating elements.

6. Airflow switches for proof of airflow.

7. Fan interlock contacts.

8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).

9. Magnetic contactor for each step of control (for three-phase coils).

L. Factory-Mounted and Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.

1. Control Transformer: Factory mounted for control voltage. Coordinate equipment voltage requirement with electrical plans.

2. Wiring Terminations: Coordinate required wiring diagrams with Building Automation System controls subcontractor.

3. Disconnect Switch: Factory-mounted, non-fuse type in control panel.

4. The following equipment items are to be furnished by Specification Section 23 09 23 - Direct-Digital Controls and installed by air terminal unit manufacturer.

   a. Auto temperature control card (DDC).
   b. 24-volt damper actuator.

5. The following equipment items are to be furnished and installed by the air terminal unit manufacturer:

a. Volume Control Damper.
b. Multi-point flow sensor.
c. Controller enclosure.
d. Power transformer (Coordinate voltage with electrical plans).

M. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

N. Sound Ratings: Not to exceed 35 NC at one (1) inch static pressure. Sound performance shall be ARI certified.

1. Maximum discharge sound power level of 62 DB.
2. Maximum radiated sound power level of 70 DB.
3. DB level based on third octave band.

O. Temperature sensor provided, wired, and installed by Building Automation System Control Contractor: Refer to Section 23 09 23 – Direct Digital Controls.

P. For Sequence of Operation: Refer to Section 23 09 93.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install ceiling access doors or locate units above easily removable ceiling components.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

A. Install piping adjacent to air terminal unit to allow service and maintenance.

B. Hot-Water Piping: In addition to requirements in Section 232113 "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Connect ducts to air terminal units according to Section 233113 "Metal Ducts."

D. Coordinate duct installations and specialty arrangements with Drawings.

E. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air terminal unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.

3. Verify that controls and control enclosure are accessible.

4. Verify that control connections are complete.

5. Verify that nameplate and identification tag are visible.

6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

3.8 ADJUSTING

A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to 0 percent full flow. Set units with heating coils for minimum 50 percent full flow.

END OF SECTION 23 36 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Air devices.

1.3 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.

2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

C. Test Reports: Rating of air outlet and inlet performance.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Air Devices shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 AIR DEVICES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Titus
2. Price
3. Metalaire
4. Kruger

B. Mounting:

1. Plaster Surfaces: Provide with plaster frames or plaster rings to make airtight seal against mounting surface.

2. "T" Bar Ceilings: Lay-in type.

3. Gyp Board and Wall surfaces: 1-1/2" overlap flange.

C. Fire rated diffusers for fire rated roof/ceiling assembly: Refer to diffuser schedule for fire rated assembly requirement.

1. UL classified fire rated ceiling diffuser assembly listed in The Underwriters Laboratories "Fire Resistance Directory".

2. Shall have a fire resistance rating of 3 hours.

3. Heavy Gauge Steel Diffusers shall be tested in accordance with UL 263 and must meet NFPA 90A requirements. Diffusers must be able to operate in (3) three-hour fire rated ceiling and must be installed in accordance with the installation instructions.

4. UL 555C Fire resistance rating: 3-hour ceiling radiation damper with fusible link assembly. Fire closure temperature of 165°F.

5. UL listed thermal blanket insulation, mineral fiber around entire diffuser.

6. Complete fire rated damper assembly with blanket shall be provided and submitted by/with Diffusers, Registers, and Grilles.

D. Source Quality Control

1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

E. Accessories:

1. Square to round neck adapter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify inlet and outlet locations.

B. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Verify ceiling and wall systems are ready for installation.

E. Refer to Architectural Code Information and Fire Rated Assemblies Drawing to verify if ceiling is fire rated. If ceiling is fire rated provide U.L. tested radiation damper with thermal blanket for all ceiling mounted supply and return air grilles.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers

B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00 – Air Duct Accessories.

C. Install diffusers, registers, and grilles level and plumb.

D. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure

drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

F. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 91 00.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.5 SCHEDULES:

A. Refer to Drawings.

END OF SECTION 23 37 13

SECTION 23 51 00 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Category IV Condensing Appliance double wall metal vents.

B. Related Sections:

1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers and supports for placement by this section.

1.3 REFERENCES

A. Underwriters Laboratories Inc.:

1. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances.
2. UL 378 - Draft Equipment.
3. UL 441 - Gas Vents.
4. UL 641 - Type L Low-Temperature Venting Systems.
5. UL 959 - Medium Heat Appliance Factory Built Chimneys.

1.4 DESIGN REQUIREMENTS

A. Design refractory lined metal stacks for wind loading of 110 mph.

1.5 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Flue pipe shall be provided and submitted by boiler sales representative submitting on project. Flue pipe shall not be submitted separately by a third party, sheet metal contractor, mechanical contractor, etc.; no exception. Flue piping shall be submitted concurrently, but separately, at the same time as boilers.

C. Manufacturer shall provide a ¼" = 1'-0" scaled drawing within submittal showing flue pipe routing in plan and elevation views. Drawing of flue routing must be provided with dimensions showing code required distances away from intake hoods, intake louvers, etc. Include dimensions from finished roof to top of flue. Flue gasses discharged must not recirculate back into building by winds or inadequate spacing between any building envelope intakes.

D. Product Data: Submit data indicating factory-built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics, and connection requirements.

E. Product Data: Submit data on draft fans and accessories including fan curves with specified operating point plotted, power, RPM, and electrical characteristics and connection requirements.

F. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. All products furnished under this Section shall conform to the requirements of NFPA-211. Products shall be listed to UL-103 and shall carry the appropriate UL and cUL listing mark or label.

B. Flue pipe shall be provided and submitted by boiler manufacturer submitting on project.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain water integrity of roof during and after installation of chimney or vent.

PART 2 - PRODUCTS

2.1 CATEGORY IV CONDENSING APPLIANCE DOUBLE WALL METAL VENTS

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Metal-Fab
2. Heat-Fab
3. Simpson Dura-Vent
4. Ampco

B. Fabrication: Inner pipe of sheet AL29-4C and outer pipe of 430 stainless steel, tested in compliance with UL 441.

C. All products furnished under this Section shall conform to the requirements of The National Fuel Gas Code, NFPA-54; and NFPA-211, the Standard for Positive Pressure Condensing Appliances. Products shall be listed to UL-441 and shall carry the appropriate UL or cUL listing mark or label.

D. The vent shall be of the double-wall, factory-built type for use with approved Category IV condensing appliances burning natural or LP gas, which produce flue gases exhausted at temperatures not exceeding 550º F.

E. The vent shall be constructed of an outer wall of 430 stainless steel, .018" thick for sizes 3" to 14" diameter, and .024" thick for sizes 16" to 30"diameter. The inner wall shall be constructed of AL29-4C, .035" thick for sizes 3" to 8" diameter and .048" thick for sizes 10" to 30" diameter. The vent shall include an integral, annular insulating air space, 1/4" thick for sizes 3" to 6" diameter and 1/2" thick for sizes 7" to 30" diameter.

F. Edges of inner and outer walls shall be sealed and joined according to manufacturer installation instructions.

G. All fittings, flashing, storm collar, cap, and appliance adapter required to install the vent shall be included.

H. Vent shall be tested and listed for a minimum clearance to combustibles of 1" for sizes 3" to 24" diameter and 2" for sizes 26" to 30" diameter.

I. Vent shall terminate as required by code.

J. Vent shall be installed in accordance with the vent manufacturer's installation instructions, UL listing and state or local codes.

K. Warranty: Furnish 1-year manufacturer warranty for manufactured units to begin at substantial completion.

L. Accessories, UL labeled:

1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.

2. Stack Cap: Consists of conical rain shield with inverted cone for partial rain protection with low flow resistance.

3. Exterior pipe and fittings shall be constructed entirely of type 304 stainless steel.

M. Application: Category IV Condensing Gas Appliances.

PART 3 - EXEXCUTION

3.1 PREPARATION

A. Install concrete inserts for support of breeching, chimneys, and stacks in coordination with formwork.

3.2 INSTALLATION - GENERAL

A. Install in accordance with NFPA 54.

B. Install breeching with minimum of joints. Align accurately at connections, with internal surfaces smooth.

C. All double wall gas vents maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories for complete installation.

D. Install vent dampers, locating close to draft hood collar, and secured to breeching.

E. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.

F. Level and plumb chimney and stacks.

G. Clean breeching, chimneys, and stacks during installation, removing dust and debris.

H. Install slip joints allowing removal of appliances without removal or dismantling of breeching, breeching insulation, chimneys, or stacks.

I. Provide the appropriate and/or applicable chimney system continuous from appliances.

3.3 ENGINE EXHAUST AND BOILER STACK

A. Installation shall conform to the manufacturer's installation instructions, UL listing and state or local codes.

B. Support system from building structure using rigid structural shapes for attachment of fixed point supports (Plate Support Assembly). Anchor supports to structure by welding to inserts, bolting, steel expansion anchors or concrete inserts. Size of structural shapes shall be in accordance with manufacturer's recommendations.

C. Protect incomplete installations by attaching temporary closures over open ends of sections.

D. Clean all system sections of dust and debris prior to final connection to appliances.

E. Maximum unsupported horizontal spacing shall be nine (9) feet between guides.

F. Maximum unsupported vertical spacing shall be 19 feet between guides.

G. Pipe to be routed to minimize flow resistance.

H. Provide double wall bellows joint between each support and for every three (3) inches of expected expansion.

I. Provide support at roof penetration to support free standing of exhaust above roof and to keep stack centered in ventilated thimble assembly.

J. Provide drain bucket at bottom of vertical stack, piped to nearest floor drain.

K. Provide ventilated thimble and storm collar at roof penetration.

L. Provide flip top fitting at stack termination or engine exhaust.

M. Provide stack cap on boiler stack termination.

END OF SECTION

SECTION 23 52 16 - CONDENSING BOILER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Heating water boiler heat exchanger.

2. Boiler control panel.

3. Hot water boiler trim.

4. Natural gas fired burner.

B. Boiler shall be completely factory assembled and tested on a structural steel base and be ready for water, gas, and electric connections.

C. Boiler and all components shall be CSA certified.

1. ASME Section IV (Heating Boilers)
2. ANSI Z21.13 / CSA 4.9 (Gas Fired Low Pressure Boilers)
3. NFPA 54 (ANSI Z221.3)National Fuel Gas Code
4. ASME CSD-1 (Controls and Safety Devices)

D. Related Sections:

1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolators for placement by this section.

2. Section 23 11 23 - Gas Piping: Execution requirements for gas piping connections to boilers specified in this section.

3. Section 23 51 00 - Breechings, Chimneys, and Stacks: Execution requirements for breeching, chimney, and stack connections to boilers specified in this section.

4. Division 26 - Wiring Connections: Execution requirements for electric connections to boilers specified in this section.

1.3 REFERENCES

A. ASME Section IV (Heating Boilers)

B. ANSI Z21.13/CSA 4.9 (Gas Fired Low Pressure Boilers)

C. NFPA 54 (ANSI Z221.3) National Fuel Gas Code

D. ASME CSD-1 (Controls and Safety Devices)

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Flue pipe as specified per 23 51 00 Breechings, Chimneys, and Stacks, shall be provided and submitted by boiler sales representative submitting on project. Flue pipe shall not be submitted separately by a third party, sheet metal contractor, mechanical contractor, etc.; no exception. Flue piping shall be submitted concurrently, but separately, at the same time as boilers.

C. Product Data: Submit capacities and accessories included with boiler. Include general layout, dimensions, size and location of water, fuel, electric and vent connections, electrical characteristics, weight and mounting loads.

D. Test Reports: Indicate boilers meet or exceed specified performance and efficiency. Submit results of combustion test.

E. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Manufacturers Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.6 QUALITY ASSURANCE

A. Conform to ASME Section IV for construction of boilers. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.

B. Gas Train and Safety Controls: Industrial Risk Insurers.

C. Unit Certification: CSA certified.

D. Boilers shall comply with 2012 International Energy Conservation Code.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Boilers shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 WARRANTY

A. The boiler manufacturer shall provide an entire boiler parts and labor warranty (including circulating pump) for a period of **five (5) years**. Warranty shall begin from date of Certificate of Substantial Completion. Provide manufacturer's warranty certificates as described below. Warranty start dates from shipment or startup will not be accepted.

B. Provide an extended parts and labor warranty for the following:

1. Burner and Heat Exchanger: Five (5) years from date of substantial completion.

2. Thermal shock: Ten (10) years from date of substantial completion.

C. In addition to entire parts and labor warranty, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, and any expenses related to service calls required to diagnose and correct warranty issues.

D. The manufacturer shall provide factory certificates for each boiler listing at a minimum the model, serial number and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.

E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.10 GENERAL

A. Each factory "packaged" boiler shall be complete with all components, accessories, and appurtenances necessary for a complete and operable boiler as hereinafter specified. Each unit shall be furnished factory assembled with required wiring and piping as a self-contained unit. Each unit shall be readily transported and ready for installation.

B. Each factory "packaged" boiler, including pressure vessel, trim, valve trains, burner, control system, and all related components, accessories and appurtenances as herein specified shall all be assembled and furnished by the boiler manufacturer. The boiler

manufacturer shall provide unit responsibility for the engineering, coordination, workmanship, performance, warranties, and all field services for each factory "packaged" boiler as specified herein. The boiler manufacturer shall be fully responsible for all components assembled and furnished by him whether or not they are of his own manufacture.

PART 2 – PRODUCTS

2.1 CONDENSING BOILERS

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Refer to Specification 01 23 00 Alternates for acceptable manufacturers.

2. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.

B. Each boiler shall be capable of operating continuously at rated capacity while maintaining a CSA certified efficiency of not less than 97 % on 500 MBH input boilers and less and not less than 97% on larger than 500 MBH input boilers. Each boiler shall be capable of operating with a minimum outlet water temperature of 68º F.

C. Boiler shall comply with ASME Section IV for 80 psig, max 200º F (100 psig on 1500 MBH and larger units).

D. Fuel shall be natural gas with an assumed higher heating value of 1,030 Btu/Cu Ft and an assumed specific gravity of 0.60 (relative to air). Natural gas shall be supplied at a pressure of no less than 3.5 in.wc. to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14 in.wc.

2.2 BOILER DESIGN

A. Each hot water boiler shall consist of a stainless-steel primary only heat exchanger complete with trim, valve trains, burner, and boiler control system. The boiler manufacturer shall fully coordinate the boiler as to the interaction of its elements with the burner and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified. Boilers requiring a secondary heat exchanger (economizer) to achieve condensing operation will not be permitted as well as copper-finned heat exchangers.

B. Each boiler heat exchanger shall be stainless-steel, counter-flow design for maximum heat transfer with the multiple sections arranged in a reverse return configuration to assure balanced flow through each section.

C. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

D. All boiler pressure parts shall be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code, Section IV, and shall be so stamped.

E. Boiler heat exchanger headers, tube sheets, fire-tubes, and combustion chamber shall be fully welded stainless steel and have a removable burner opening for inspection.

F. Boiler shall be enclosed with a single wall outer casing. It shall be fabricated from minimum 16-gauge carbon steel. The front and top wall shall be secured in place with ¼ -

20 NC bolts (sheet metal screws are not acceptable). The complete outer casing shall be finished, inside and out, with a powder coat finish. The composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and materials to assure an outer casing temperature of not more than 50°F above ambient temperature when the boiler is operated at full rated load.

G. An observation port shall be located on the boiler to allow for observation of the burner flame.

H. Flue gas outlet shall be located on the rear of the boiler. Boiler to be certified for installation with Category IV venting (stack) as defined in NFPA 54 (ANSI Z221), latest edition. The boiler sales representative must provide venting (stack) certified for installation on a Category IV appliance in accordance with 23 52 16 – 1.4.B.

2.3 BOILER TRIM

A. Each boiler shall be provided with all necessary trim. Boiler trim shall be as follows:

1. Safety relief valve shall be provided in compliance with the ASME code. Contractor to pipe to acceptable drain.
2. Water pressure-temperature gauge.
3. Primary low water flow fuel cutoff (probe type with manual reset).
4. Manual reset high limit water temperature controller.
5. Operating temperature control to control the sequential operation of the burner.

2.4 BOILER FUEL BURNING SYSTEM

A. The boiler manufacturer shall furnish each boiler with an integral, power type, straight gas, fully automatic fuel burner. The fuel burner shall be an assembly of gas burner, combustion air blower, valve train, and ignition system. The burner manufacturer shall fully coordinate the burner as to the interaction of its elements with the boiler heat exchanger and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.

B. Each burner shall be provided with an integral gas firing combustion head.

C. Each burner shall provide adequate turbulence and mixing to achieve proper combustion without producing smoke or producing combustibles in the flue gases.

D. Each boiler shall be provided with an integral variable speed power blower to premix combustion air and fuel within the blower. The combustion air blower shall have sufficient capacity at the rated firing rate to provide air for stoichiometric combustion plus the necessary excess air. Static and total pressure capability shall comply with the requirements of the boiler. The blower shall be a maximum of 900 watts and operate at 6,000 RPM maximum without undue vibration and noise and shall be designed and constructed for exposure to temperatures normal to its location on the boiler. The operating fan speed will be tachometer sensed and be capable of being displayed at the LED display.

E. Each burner shall of the radial-fired (down-fired) type and constructed of steel with a stainless-steel inner and stainless-steel mesh outer screen.

F. Each boiler shall be provided with a “Full Modulating” firing control system whereby the firing rate is infinitely proportional at any firing rate between 20% and 100% as determined by the pulse width modulation input control signal. Both fuel input and air

input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.

G. The Microprocessor shall use a Proportional Integral Algorithm to determine the firing rate. The control must have the following capabilities:

1. Maintain single set point

2. Reset the set point based on outdoor air temperature.

3. Boiler shutdown based on outdoor air temperature.

4. Internal dual set point program with an external switchover. (e.g. - night setback w/external clock, supplied by others)

5. Alarm relay for any for any manual reset alarm function.

6. Programmable Low Fire Delay to prevent short cycling based on a time and temperature factor for release to modulation.

7. LED Display showing current supply and return temperatures, current set points as well as differential set points. It must also display any fault codes whether automatically reset or manually reset.

8. Local Manual Operation.

9. Remote Control System (Building Management / Sequencer Control) - The boiler control shall be capable of accepting a 0 -10vdc remote external analog signal to control the firing rate.

10. Computer (PC) interface for programming and monitoring all functions

2.5 MAIN GAS VALVE TRAIN

A. Each boiler shall be provided with an integral main gas valve train. The main gas valve trains shall be factory assembled, piped, and wired. Each gas valve train shall include at least the following:

1. Two (2) safety shutoff valves. Valves equipped with dual solenoids that can independently energized for leak testing.

2. Air – Gas ratio control (maximum inlet pressure 14 in.wc.)

3. One (1) low gas pressure switch (manual reset).

4. One (1) high gas pressure switch (manual reset).

5. Two (2) pressure test ports.

2.6 IGNITION SYSTEM

A. Each boiler shall be equipped for direct ignition or proven pilot ignition.

2.7 COMBUSTION AIR CONTROL

A. Each boiler shall be provided with an integral combustion air control system. The combustion air system shall be factory assembled. Each combustion air control system shall include at least the following:

1. The primary control shall vary the speed of the blower based on load demand. The blower shall apply a varying negative pressure on the gas valve which will open or close to maintain zero pressure at the valve orifice, thereby increasing or decreasing the firing rate. Both the air and gas shall be premixed in the blower.

2. One (1) low airflow differential pressure switch to ensure that combustion air is supplied.

3. High exhaust back pressure switch

2.8 BURNER CONTROL SYSTEM

A. The control system shall be supplied with a 24 VAC transformer (120 VAC, single phase, 60 hertz primary). The power supply to each boiler shall be protected by a circuit breaker located in the MCC (supplied by contractor).

B. The boiler shall include direct ignition or proven pilot ignition system. Main flame shall be monitored and controlled by flame rod (rectification) system.

C. Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.

D. Each boiler control system shall provide timed sequence pre-ignition air purge of boiler combustion chamber. The combustion airflow sensor shall monitor and prove the airflow purge.

2.9 BURNER CONTROL PANEL

A. The boiler manufacturer shall provide each boiler with an integral factory prewired control panel. The control panel shall contain at least the following components, all prewired to a numbered terminal strip:

1. One (1) burner "on-off" switch.

2. One (1) electronic combination temperature control, flame safeguard and system control.

3. Control circuit breaker, 5 amp

4. All necessary control switches, pushbuttons, relays, timers, terminal strips, etc.

5. LED Display Panel to adjust set points and control operating parameters. LED display to indicate burner sequence, all service codes (0-65), fan speed, boiler set point, and sensor values such as inlet, outlet, flue gas and outdoor air.

2.10 BUILDING AUTOMATION SYSTEM INTERFACE:

A. Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. A BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed locally at boiler control panel shall be available through building automation system.

2.11 FACTORY TESTING – HYDROSTATIC

A. Each factory "packaged" boiler shall be hydrostatically tested and bear the ASME “H” stamp.

2.12 FACTORY TESTING – FIRE TESTING

A. Each factory "packaged" boiler shall be fire tested. The boiler manufacturer shall perform this fire test under simulated operating conditions, with the boiler attached to a working chimney system and with water circulating through the boiler. The manufacturer shall provide a fire test report, including fuel and air settings and combustion test results permanently affixed to the boiler.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install boilers plumb and level, to plus or minus 1/16 inch over boiler base. Stacking of boilers is unacceptable.

B. Maintain manufacturers recommended and code minimum clearances around and over boilers.

C. Install boiler on concrete housekeeping pad, minimum four (4) inches high and six (6) inches larger than boiler base on each side. Refer to Section 23 05 29 - Hangers and Supports For HVAC Piping and Equipment.

D. Install boiler on vibration isolators in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

E. Connect natural gas piping in accordance with NFPA 54.

F. Connect natural gas piping to boiler, full size of boiler gas train inlet. Arrange piping with clearances and unions for burner removal and service.

G. Connect hot water piping to supply and return boiler connections.

H. Install the following piping accessories. Refer to Section 23 05 19 - Meters and Gages For HVAC Piping.

1. On supply:

a. Thermometer well for temperature controller.

b. Thermometer well and thermometer.

c. Well for control system temperature sensor.

d. Strainer.

e. Nipple and flow switch.

f. Pressure gage.

g. Shutoff valve.

2. On return:

a. Thermometer well and thermometer.

b. Well for control system temperature sensor.

c. Pressure gage.

d. Shutoff valve.

e. Balancing valve.

I. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23 - Gas Piping.

1. Strainer.

2. Pressure gage.

3. Shutoff valve.

4. Check valve.

5. Pressure reducing valve.

6. Unions.

J. Install discharge piping from relief valves and drain valves to nearest floor drain.

K. Install boiler trim and accessories furnished loose for field mounting.

L. Install electrical devices furnished loose for field mounting.

M. Install control wiring between boiler control panel and field mounted control devices.

N. Connect flue to boiler outlet, full size of outlet.

O. Route each gas trim vent, separately, to the outdoors. Vent lines sizes shall be a minimum the equivalent size pipe connection. Provide union at each device to facilitate change-out and in the vertical to allow the burner door to swing open. Terminate vents a sufficient distance from air intakes, turn down and provide insect screen.

P. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

3.2 FIELD QUALITY CONTROL

A. Perform combustion test including boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent NOx, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.

B. Arrange with local authorities having jurisdiction for inspection of boiler, piping, and for certificate of operation. Provide written certification from boiler manufacturer that installation is in compliance with manufacturer's written instructions.

C. Prior to boiler startup, Contractor to inform Owner to have boiler inspector inspect installation for proper installation and submit for State Operating Certificate.

3.3 BOILER INSPECTION REQUIREMENTS

A. All new boilers, regardless of new construction or renovation of existing systems, are required to receive inspection by a state boiler inspector or their assigned agent prior to any boiler being energized, no exceptions. A boiler requiring inspection is generally defined by the following characteristics.

1. Heat input exceeds 200,000 Btuh.

2. Nominal water-containing capacity exceeds 120 gallons.

B. As per Boiler Safety Administration Rules, 65.20, The Owner or operator are the only persons that can submit a request for inspection of a boiler by the state or their agent. The inspection agent has at least 30 days to schedule an inspection date with the Owner. During an emergency situation where a boiler is replaced due to mechanical failure of an existing boiler, the agent may grant approval to the Owner to allow startup before inspection but that is at the agent’s discretion.

C. The installing contractor is required to submit the following documents to the Owner before the Owner can submit for state inspection.

1. Contractor shall complete the attached Boiler Inspection Installation Report and notify the district HVAC department personnel in charge of maintaining all inspection certification documentation for the district.

2. Contractor shall submit all manufacturer’s cut sheets and product information on boiler being inspected.

3. Hydrostatic test results on boiler being inspected.

4. Contractor shall submit this information to the Owner in a timely manner so the inspection can be scheduled and performed prior to project completion.

D. As per the Health and Safety Code, Chapter 755, September 1, 2003.

1. Nuclear, high pressure or steam boilers must receive an annual certificate of inspection and an annual external inspection if they meet these characteristics.

a. Pressures exceeding 160 psi.

b. Temperatures exceeding 250 degrees Fahrenheit

2. Steam heating boilers and hot water heating boilers shall be inspected biennially (every two years) if they meet these characteristics:

   a. Pressures not exceeding 160 psi.
   b. Heat input exceeds 200,000 Btuh.
   c. Water temperature greater than 210 F but not greater than 250 degrees Fahrenheit
   d. Nominal water-containing capacity exceeds 120 gallons.

3. Hot water supply boilers shall be inspected triennially (every three years) if they meet these characteristics:

   a. Pressures not exceeding 160 psi.
   b. Heat input exceeds 200,000 Btuh.
   c. Water temperature not exceeding 210 degrees Fahrenheit; or Nominal water-containing capacity exceeds 120 gallons.

E. Inspection Responsibilities

1. Preparing the boiler for inspection is listed in the Boiler Safety Administrative Rules, Section 65.70.

   a. Water shall be drawn off and the boiler thoroughly washed.

   b. All manhole and hand hole plates, washout plugs, and plugs in the water column connections shall be removed as necessary for complete inspection. The furnace and combustion chambers shall be thoroughly cooled and cleaned.

   c. All grates and internally fired boilers shall be removed.

   d. Brickwork shall be removed as required by the inspector in order to determine the condition of the boiler, headers, furnace, supports or other parts.

   e. The pressure gage shall be removed for cleaning of the siphon and testing, if necessary.

   f. The low water cutoff device shall be dismantled, cleaned, and prepared for inspection.

   g. Before removing the manhole or hand hole covers and entering any part of the boiler connected to a common header with other boilers any leakage of steam or hot water shall be eliminated. The non return and stop valves must be closed, tagged, and preferably padlocked, and drain valves between the two valves opened. The feed water valves must be closed, tagged, and preferably padlocked. After draining the boiler, the blowdown valves shall be closed and preferably padlocked. Blowdown lines, where practicable, shall be disconnected between pressure parts and valves. All vent and drain lines shall be opened.

   h. If the boiler is jacketed so that the seams of shells, drums or domes cannot be seen, enough of the jacketing, setting wall, or other form of casing or housing shall be removed to permit inspection to determine the safety of the boiler, provided such information cannot be determined by other means.

2. For initial boiler inspection after installation:

   a. Once an inspection date has been established between the inspector and Owner, the boiler manufacturer's representative shall be available on-site for boiler inspection.

   b. The manufacturer's representative shall make the boiler available for inspection as per procedures listed above or tests as required by the inspector.

   c. The manufacturer's representative will be responsible to re-assemble boiler back to its original state and then schedule a startup test with the installing contractor and Owner. All product warranties shall begin once startup has been completed and unit is available for use as designed.

3. For annual boiler inspection:

   a. Once an inspection date has been established between the inspector and Owner, the Owner or their assigned contractor shall be available on-site for boiler inspection.

   b. The Owner or their assigned contractor shall make the boiler available for inspection as per procedures listed above or tests as required by the inspector.

   c. The Owner or their assigned contractor will be responsible to re-assemble boiler back to its original state and place the boiler in good working condition.

3.4 MANUFACTURER'S FIELD SERVICES

A. Start-up boilers according to manufacturer's start-up instructions and in presence of boiler manufacturer's representative and Owner's representative. Test controls and demonstrate compliance with requirements. Adjust burner for maximum burning efficiency. Replace damaged or malfunctioning controls and equipment.

3.5 CLEANING

A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's start-up instructions.

3.6 DEMONSTRATION

A. Demonstrate operation and maintenance procedures.

B. Furnish services for manufacturer's technical representative for one (1) 8-hour day to instruct Owner's personnel in operation and maintenance of boilers. Schedule training with Owner, provide at least seven (7) days notice to Architect/Engineer of training date.

END OF SECTION 23 52 16

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 64 23 - SCROLL WATER CHILLERS AIR-COOLED

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes chiller package, controls and control connections, chilled water connections, starters, and electrical power connections.

B. Related Sections:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment - Product requirements for Vibration Isolators for placement by this section.

3. Section 23 05 19 Meters and Gages for HVAC Piping: Product requirements for piping specialties for placement by this section.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.

E. KW/Ton (kW/kW): The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons (kW) at any given set of rating conditions.

F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

1.4 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 550/590 - Water Chilling Packages Using the Vapor Compression Cycle.

EQUIPMENT SHALL BID AS AN ALTERNATE

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
2. ASHRAE 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.

C. American Society of Mechanical Engineers:

1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. Underwriters Laboratories Inc.:

1. UL 1995 - Heating and Cooling Equipment.

1.5 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.

C. Shop Drawings: Indicate components, assembly, dimensions, weights, and loads, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.

D. Product Data: Submit rated capacities, specialties and accessories, electrical requirements, and wiring diagrams.

E. Design Data: Indicate energy input versus cooling load output from 25 to 100 percent of full load at specified and minimum condenser water temperature.

F. Test Reports: Indicate results of factory performance test.

G. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

H. Manufacturer's Certificate: Certify products meet or exceed specified requirements including components not produced by manufacturer.

I. Manufacturer’s Field Reports: Submit start-up report for each unit. Indicate results of leak test and refrigerant pressure test.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural supports.

2. Piping roughing-in requirements.

3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.

EQUIPMENT SHALL BID AS AN ALTERNATE

4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Source quality-control reports.

D. Startup service reports.

E. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble- shooting guide.

1.8 QUALITY ASSURANCE

A. ARI Certification: Certify chiller according to ARI 550 certification program.

B. ARI Rating: Rate chiller performance according to requirements in ARI 550/590.

C. ASHRAE Compliance:

1. ASHRAE 15 for safety code for mechanical refrigeration.

2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

E. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1[, as applicable to chiller design]. For chillers charged with R-134a refrigerant, include an ASME U-stamp and nameplate certifying compliance.

F. Comply with NFPA 70.

G. Comply with requirements of UL and UL Canada and include label by a qualified testing agency showing compliance.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

B. If chiller is mounted on structural-steel support structure coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

1.10 WARRANTY

A. The chiller manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of one (1) year. Warranty shall begin from date of Certificate of Substantial

Completion. Provide manufacturer's warranty certificates as described below. Warranty start dates from shipment or start up will not be accepted.

B. Provide an extended four (4) year FULL machine parts, labor, and refrigerant warranty for chillers. All chiller components to be included such as but not limited to refrigerant, compressors, motors, starters, variable frequency drives, condenser coils, evaporator coils, fans, controls, and gear assemblies (as applicable) etc. In the event of failure, the chiller manufacturer shall provide a new motor, compressor, drive assembly, etc. Local or field rebuilt motors, compressors, drive assemblies etc. are not acceptable.

C. In addition to full machine parts, labor and refrigerant, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation, and any expenses related to service calls required to diagnose and correct warranty issues.

D. All components replaced through the warranty process shall be new and not used or re-built.

E. The manufacturer shall provide factory certificates for each chiller listing as a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.

F. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

G. Provide quarterly inspections, four (4) per year, by factory direct technician. Provide the owner a minimum of one week's notice prior to inspection.

1.11 PREVENTATIVE MAINTENANCE SERVICE

A. Furnish service and maintenance of chillers for period of five (5) years from Date of Substantial Completion.

B. Include, on a quarterly basis, systematic examination, required adjustments, lubrication of unit and controls calibration. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use new parts produced by manufacturer of original equipment.

C. Perform work without removing units from service during building normal occupied hours. Off-line chiller work must be coordinated with Owner.

D. At an additional cost to owner provide emergency call back service at all hours during this maintenance period.

E. Maintain locally adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

F. All maintenance work shall be performed by factory direct service technician. Maintenance work shall not be performed by installing mechanical contractor.

G. Do not assign or transfer maintenance service to agent or subcontractor.

EQUIPMENT SHALL BID AS AN ALTERNATE

1.12 DELIVERY, STORAGE, AND HANDLING

A. Chillers shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

F. Protect units from physical damage. Leave factory covers in place until startup of machine.

PART 2 – PRODUCTS

2.1 SCROLL WATER CHILLERS AIR-COOLED

A. Acceptable Manufacturers: Subject to compliance with specification and mechanical drawing requirements, provide products by one of the following:

1. Refer to Specification 01 23 00 Alternates for acceptable manufacturers.

2. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.

B. Product Description: Factory assembled and tested, packaged air-cooled liquid chiller consisting of semi-hermetic rotary screw or hermetic scroll compressors, suction gas-cooled compressor motor, condenser coils, evaporator, refrigeration accessories and control cabinet with single point power connection.

EQUIPMENT SHALL BID AS AN ALTERNATE

2.2 UNIT IDENTIFACTION REQUIREMENTS

A. Furnish each unit with a durable, deep etched, .025” thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Unit identification as indicated within Contract Documents.
- Serial Number.
- Model Number.
- Capacity (tonnage).
- Entering and leaving water temperature.
- Flow rate (GPM).
- Unit Power Supply: Volts / PH / Amps; MCA / MOCP
- Refrigerant type.
- Sales Order #.
- Date of unit manufactured.

2.3 COMPRESSORS

A. Scroll Compressors:

1. Unit: Direct drive, hermetic, fixed compression, scroll motor-compressor with control panel.

2. Features: Centrifugal oil pump, sump oil heater, oil level sight glass, oil charging valve, two-point lubrication for each motor bearing, flooded lubrication for journal and thrust bearings, check valve on scroll discharge port.

3. Motor: Suction-gas cooled hermetically sealed, squirrel cage induction type.

4. Automatic Capacity Reduction: Electronic logic controller and air temperature sensor controls unit and hot gas bypass regulator valve.

5. Provide complete refrigerant charge of **R-32** or **R-454B** and oil charge.

B. Lube oil system shall include filtration devices with proper valves for removal of filter without removal of refrigerant charge.

C. Ultra Low Sound Compressor Control: Chiller manufacturer shall provide the following attenuation package and meet scheduled maximum A-weighted sound pressure level rating as shown on schedule at 30’ from the condenser coil side of chiller per AHRI. Complete sound attenuation package shall be provided regardless of if scheduled dBA is met without.

1. Acceptable sound attenuation package manufacturer: BRD-Noise and Vibration Control Inc. (Factory attenuation packages only are not acceptable)

2. Complete Ultra-low sound package shall be manufactured by BRD – Noise and Vibration Control, Inc., Hushcore™ Product line, no exceptions.

Contact: Kristopher Gonzalez – (610) 881-4490

3. Provide ultra-low sound blanket on a minimum of 100% coverage of each compressor, suction line, discharge line and oil separator: no exceptions.

EQUIPMENT SHALL BID AS AN ALTERNATE

4. Removable Sound Covers shall be constructed with a Silicone-fiberglass cloth outer jacket, a loaded vinyl barrier septum, fiberglass needle mat (11 lbs./ft.^{3} density), and a Silicone-fiberglass cloth inner jacket. The covers shall be connected together by means of a cloth straps with "D" rings and Velcro™ fasteners. The inner and outer jackets shall protect against UV rays, oil and water. Finished Surface Mass – 3 lbs. per sq. ft., to cover compressors and extended components for the specified chiller. Stainless steel wire tie fastening assemblies are not acceptable.

5. Provide detailed ultra-low sound acoustical data with submittal, no exceptions. Data shall include sound pressure rating across each octave band and A-weighted average for chiller as built with attenuation package.

2.4 EVAPORATOR

A. Shell and tube type, seamless or welded steel construction with cast iron or fabricated steel, heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Furnish multiple refrigerant circuits on multiple compressor units. Include a minimum of two (2) circuits.

B. Design, test, and stamp refrigerant side for 445 psig working pressure and water side for 150 psig working pressure, in accordance with ASME Section VIII.

C. Furnish water boxes, with tapped drain and vent connections with flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant.

D. Furnish refrigerant chambers with baffles to distribute entering liquid and separate liquid from leaving gas.

E. Insulate with 0.75-inch minimum thick, closed cell foam, vapor barrier insulation with a maximum K factor of 0.26. Provide heat tape with thermostat to protect evaporator from freezing down to 0º F. ambient.

F. Furnish water drain connection and thermometer wells for temperature controller and low temperature cutout.

G. Provide fusible plug in accordance with ASHRAE-15.

2.5 CONDENSER COILS, FANS AND MOTORS

A. Coils: Aluminum Fins mechanically bonded to seamless copper tubing. Furnish sub-cooling circuits as applicable. Air test under water to 425 psig, and vacuum dehydrate. Seal with holding charge of nitrogen or refrigerant. Coils shall have a factory applied post-construction, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5-year warranty, from the date of substantial completion. **Microchannel condenser coils shall not be acceptable.**

EQUIPMENT SHALL BID AS AN ALTERNATE

B. Louvered/Wire Panels: Factory installed louvered panels on external condenser coil faces, painted to match unit panels. Factory louvered panels around the base and ends of the machine to restrict unauthorized access.

C. Low Sound Fans: Reduced rpm, vertical direct driven propeller type condenser fans with fan guard on discharge. Fans shall have a minimum of 7 polymer blades with baffling. Metal blade fans are not acceptable.

D. Fan Motors: High efficiency 8-pole low RPM motor, direct drive fan connection, 3 phase power, insulation class “F”, current protected, Totally Enclosed Air-Over (TEAO) with double sealed, permanently lubricated ball bearings.

2.6 SOUND RATINGS

A. Noise Rating: Emitted A-Weighted Sound Pressure Level shall not exceed 71 dBA at 30 feet from sides of the unit when measured according to ARI STANDARD 575.

B. Acoustic sound compressor blankets and Low Sound Fans shall be provided regardless of if scheduled dBA is met without.

2.7 REFRIGERANT CIRCUIT

A. Dual refrigerant circuits with one compressor per circuit.

B. Furnish for each refrigerant circuit:

1. Liquid line solenoid valve.
2. Filter dryer (replaceable core type without refrigerant loss or removal).
3. Liquid line sight glass and moisture indicator.
4. Electronic expansion valve.
5. Charging valve.
6. Insulated suction line.
7. Discharge line check valve.
8. Compressor discharge service valve.
9. Pressure relief device.
10. Oil separator.

2.8 CONTROLS

A. Factory mounted watertight steel control cabinet containing contactors, power and control wiring with factory wired single point power connection and non-fused disconnect switch with handle extending through face of cabinet. Control cabinet shall include microprocessor-based control system. System shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays, and switches. Control panel shall include LCD display with keypad interface. Display messages shall be plain English. A coded two- or three-character display is unacceptable.

B. Control Panel shall be NEC409 and UL508A compliant (high short circuit current rating).

C. Chiller manufacturer shall provide a BACnet interface card (gateway) in control panel. Mounting, wiring, programming, and calibration of gateway shall be provided by chiller manufacturer. Chiller supplier shall provide BAS contractor with point list and programming information as needed.

EQUIPMENT SHALL BID AS AN ALTERNATE

1. A BACnet communication network interface card with building automation system shall enable building automation system operator to remotely control and monitor the chiller from an operator workstation. Control features available, and monitoring points displayed, locally at chiller control panel shall be available through building automation system.

D. Gateway shall include the following communication ports: One Ethernet port, one serial port configurable for EIA-232 or EIA-485 and one EIA-485 serial port.

E. Gateways that transfer data in proprietary language are not acceptable.

F. Gateway shall support open protocol communication for data sharing, alarm and event management, scheduling, trending and device and network management.

G. Furnish the following safety control with indicating lights arranged so machine is shut down and requires manual reset.

1. High condenser refrigerant pressure.
2. Low oil pressure.
3. High oil temperature.
4. High motor current.
5. High motor temperature.
6. Low refrigerant (evaporator) pressure.
7. High bearing temperature.

H. Furnish the following safety controls. Operating any one control shuts down machine:

1. Low chilled water temperature.

2. Chilled Water Integral flow switches within chiller. Flow proving switches shall be thermal dispersion type (IFM U 40100 or approved equal). Switches shall be U.L. listed, SPDT snap-acting, and pilot duty rated (125 VA minimum). Flow switch shall have relay output, wire break output and temperature output. Flow switch shall be redundant; control contractor to provide flow switch within piping.

3. Loss of an electrical phase.

I. Furnish manual machine off-auto switch on control panel and the following manual or menu driven software display.

1. Machine selector switch to allow load, unload and hold or automatic operation.
2. Manual Set Point Adjustments:

    a. Leaving chilled water temperature.
    b. Current demand limit.

3. Status display:

    a. Chilled water flow proven.
    b. Cooling required.

        1. Unit running.
        2. Unit loading.
        3. Unit unloading.
        4. Manual reset required.

EQUIPMENT SHALL BID AS AN ALTERNATE

5. Remote chilled water set point active.
6. Remote current water set point active.

4. Set point and Temperature Display:

   a. Chilled water set point.
   b. Current limit set point.
   c. Entering evaporator water temperature.
   d. Leaving evaporator water temperature.
   e. Entering condenser water temperature.
   f. Leaving condenser water temperature.

5. Dial or Electronic Type Pressure Indicators.

   a. Evaporator refrigerant pressure.
   b. Condenser refrigerant pressure.
   c. Low oil pressure (oil sump).
   d. High oil pressure (oil supply).

J. Furnish the following operating controls:

1. Multi-step chilled water temperature controller to cycle compressor and activate capacity controls, with remote thermostat.

2. Five minute off timer prevents compressor from short cycling.

3. Periodic pump-out-timer to pump down on chilled water flow and high evaporator refrigerant pressure.

4. Provide low ambient control and high ambient options as required to ensure unit is capable of operation from 0°F to 115°F ambient.
5. Thermostat to cycle fan motors in response to outdoor ambient temperature.

6. Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.

7. Solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.

8. Load limit thermostat to limit compressor loading on high return water temperature.

9. Three phase monitor to protect unit by stopping compressor on phase loss, phase reversal, phase unbalance, or under voltage.

10. Provide capacity control system capable of reducing unit capacity to 10% of full load. Compressor shall start in unloaded condition. Application of factory installed hot gas bypass on screw compressors shall be acceptable as required to meet specified minimum load. For scroll compressors, hot gas bypass must be provided and sized for minimum compressor loading on one circuit only. No exceptions.

11. Cycle counter and operating hour meter.

EQUIPMENT SHALL BID AS AN ALTERNATE

2.9 MOTOR STARTER

A. For scroll compressors, furnish across-the-line starter, non-recycling compressor overload, starter relay, and factory mounted control power transformer. Furnish manual reset and current overload protection.

B. Design starter enclosure for top or bottom electrical cable entry with front access door. Furnish door with interlock to non-fused disconnect switch. Provide clips to accommodate padlock.

C. Mount the following devices within enclosure:

1. Non-fused disconnect switch online side with door interlock.

2. Pilot relays to start and stop compressor on signal from chiller control panel.

3. Electronic overload provides overload protection, protects compressor motor from distribution system irregularities, and provides motor current signal to chiller capacity control module.

4. Control power transformer.
5. Fused control circuits for control circuit, oil pump motor, oil heater, and purge control unit.

6. Contactor interlocks for communication between starter and control panel.

7. Capacitors, one for each phase, to correct power factor to minimum 95 percent.

8. Fused disconnect and starter for oil pump-if required.

9. Relay for remote mounted emergency shutdown switch.

D. Furnish the following devices on starter door or equivalent on unit control panel display:

1. Starter fault trip indicator and reset.

2. Overload trip indicator and reset.

3. Distribution fault trip indicator and reset.

4. Ground fault trip indicator and reset.

5. Ammeters, one for each phase.

6. Voltmeters, one for each phase.

2.10 CHILLER PERFORMANCE

A. Minimum efficiency shall be per current local adopted IECC Supplement Table.

2.11 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Coordinate voltage with electrical drawings, ensure Overcurrent protective device size and type, and minimum circuit capacity are provided per unit manufacturer's published data.

EQUIPMENT SHALL BID AS AN ALTERNATE

B. Factory mounted non-fused molded case disconnect switch.

C. Single point power connection and grounding lug.

D. Provide integral 120V control power transformer.

E. Provide all 120V accessory branch circuits indicated on unit manufacturer's wiring diagram, including separate connection for oil heaters.

2.12 FACTORY CAPACITY TEST

A. The chiller manufacturer shall provide the necessary special test equipment and services of a factory trained technician to conduct various capacity tests prior to delivery to the project. Tests shall verify and certify that project equipment is in compliance with the Contract Documents.

B. Four (4) copies of the tests and their results shall be submitted to the Engineer for approval within five (5) calendar days from chiller test date. If test results do not demonstrate compliance with the Contract Documents, the project chillers will be tested with required correction procedures until compliance can be certified.

C. Conform to UL 1995 code for construction of chillers and furnish UL label.

D. Conform to ASME Section VIII for construction and testing of chillers.

2.13 PUMPOUT SYSTEM-IF REQUIRED

A. Provide service valves and connections for refrigerant pump-out to remote storage tank using portable condensing unit. Valves are not required if chiller is capable of pumping the entire refrigerant charge into condenser vessel for storage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install chiller on concrete housekeeping pad minimum four (4) inches high and six (6) inches wider than chiller base on each side. Refer to Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.

B. Install units on vibration isolation. Refer to Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Install chiller accessories furnished loose for field mounting.

E. Install electrical devices furnished loose for field mounting.

F. Install control wiring between chiller control panel and field mounted control devices.

G. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit. Refer to Division 26, Electrical.

H. Provide the following piping accessories on evaporator chilled water piping connections.

EQUIPMENT SHALL BID AS AN ALTERNATE

3.2 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

B. Install piping from chiller rupture disc to outdoors. Size as recommended by manufacturer. Pipe in accordance with local codes and ASHRAE 15.

C. Comply with requirements for piping specified in Section 23 21 13 "Hydronic Piping" and Section 23 23 00 "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

D. Install piping adjacent to chiller to allow service and maintenance. Piping shall be arranged for easy dismantling to permit tube cleaning. Locate shut-off valves to permit removal of piping for access.

E. Evaporator Fluid Connections: Connect to evaporator inlet with nipple and flow switch, shutoff valve, Y-strainer, flexible connector, thermometer well for temperature controller, thermometer well and thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with flow switch with DDC interface, shutoff valve, balancing valve, flexible connector, thermometer well and thermometer, thermometer well for temperature controller, plugged tee with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a mechanical coupling manufactured by Victaulic. Refer to Sections 23 05 19 Meters and Gages for HVAC Piping and 23 21 13 Hydronic Piping.

F. Provide control wiring between chiller control panel and field mounted control devices.

G. Provide connection to electrical service.

3.3 STARTUP SERVICE

A. A factory direct authorized service representative shall perform startup service. Chiller startup shall not be performed by contractor.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Verify that refrigerant charge is sufficient, and chiller has been leak tested.

3. Verify that pumps are installed and functional.

4. Verify that thermometers and gages are installed.

5. Operate chiller for run-in period.

6. Check bearing lubrication and oil levels.

7. Verify that refrigerant pressure relief device is vented outside.

8. Verify proper motor rotation.

9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.

10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.

11. Verify and record performance of chiller protection devices.

12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.

C. Prepare test and inspection startup reports.

3.4 FIELD QUALITY CONTROL

A. Furnish cooling season start-up, winter season shutdown service, for first year of operation. When initial start-up and testing takes place in winter and machines are to remain inoperative, repeat start-up and testing operation at beginning of first cooling season.

3.5 MANUFACTURER'S FIELD SERVICES

A. Manufacturer's representative shall certify in writing that installation is in compliance with manufacturer's recommendations.

B. Furnish services of factory trained representative for minimum three (3) days to leak test, refrigerant pressure test, and start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.6 DEMONSTRATION AND TRAINING

A. Demonstrate system operations and verify specified performance. A functional test of the installed chiller control system shall be performed to demonstrate proper functioning of all interlocks and protective systems specified or otherwise required. This testing shall be conducted in the presence of the Owner's representative and the Engineer. The Contractor shall submit test procedure for approval by the Engineer prior to testing.

B. Coordinate testing with Testing and Balancing Contractor.

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean chiller externally and internally to remove foreign material and construction dirt and dust. Clean condensing coils, condensing fans, frame, etc.

B. **Prior to building occupation, contractor shall clean condenser coils free from dirt and debris.**

END OF SECTION 23 64 23

SECTION 23 74 13.16 - PACKAGED, OUTDOOR, CENTRAL-STATION HYDRONIC AIR-HANDLING UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes modular factory fabricated air-handling units and accessories.

B. Related Sections:

1. Section 23 05 00 - Common Work Results for HVAC

2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section

3. Section 23 07 16 - HVAC Equipment Insulation: Product requirements for insulation for placement by this section

4. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section

5. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section

6. Section 23 05 14 - Variable Frequency Controllers

1.3 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.

C. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

D. Product Data, Submit the following:

1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.

2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.

4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity per ARI 260.

5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.

E. Manufacturer's Installation Instructions: Submit.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. Comply with NFPA 70.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer’s protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic

materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

F. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.8 WARRANTY

A. Furnish one (1) year manufacturer parts and labor warranty for air handling units. Warranty shall begin from date of Certificate of Substantial Completion and shall not begin at shipment or start-up.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor or "by others".

1. Filters: Furnish three (3) sets for each unit. One set during construction, a new set of filters for Test and Balancing services, and final new set at substantial completion. Filters shall be protected with polyester fabric at all times during construction.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

PART 2 - PRODUCTS

2.1 PACKAGED, OUTDOOR, CENTRAL-STATION HYDRONIC AIR-HANDLING UNITS

A. Manufacturer:

1. Carrier
2. JCI
3. Trane
4. Temtrol

B. All air handling units shall be of the same manufacturer and same model; mismatched manufacturer's will not be acceptable.

C. Configuration: Coordinate with project plans and schedules.

D. Performance Base: Sea level pressure or altitude.

E. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts.

F. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts.

2.2 SPECIAL PROJECT REQUIREMENTS: CONSTRUCTION

A. In order to demonstrate energy compliance with current local IECC performance method; the project as specified and scheduled was energy modeled and complies. Alternate manufacturers are allowed but must not exceed maximum scheduled brake horsepower, efficiency, etc.

B. Air handling units shall be constructed to fit scheduled maximum dimensions including factory built mixing boxes and must maintain minimum specified access sections as scheduled and shown on plans. Rotating units to different orientations other than what is drawn on plans will be unacceptable. If potentially submitted equipment shall exceed any scheduled dimension, manufacturer shall provide performance data and dimensional data for consulting engineer to review and determine if proposed unit will fit within allotted space and maintain all required maintenance clearance. Equipment with deviations to dimensions shall be submitted 10 days prior to bid date for review.

C. Outside air / return air mixing boxes shall be factory fabricated with the same construction as the unit casing. Field supplied or installed mixing boxes are not acceptable. Dampers shall be factory installed on mixing box openings. Actuators shall be provided by the control’s contractor. This applies to all the air handling units with energy recovery wheel and any unit with outside and return air ducted to the plenum.

2.3 UNIT IDENTIFACTION REQUIREMENTS

A. Furnish each unit with a durable, deep etched, .025” thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Project name and address.
- Unit identification as indicated within Contract Documents.
- Serial Number.
- Model Number.
- CFM.
- Entering and leaving air temperature (DB/WB) (cooling and heating coil).
- Entering and leaving water temperature (cooling and heating coil).
- Cooling and heating coil flow rate (GPM).
- Fan Motor Horsepower.
- Blower est. ext. sp. (in. wg.).
- Unit Power Supply: Volts / PH / Amps; MCA / MOCP
- Sales Order #.
- Date of unit manufactured.

B. Custom label shall be provided by and installed at the factory. Label shall not be by a third party or contractor.

2.4 CASING

A. Base rail shall be a minimum of 14-gauge galvanized steel and shall be a minimum of six (6) inches in height. Base assembly shall be thermally broken and insulated with a minimum of 2” thick, R-13 closed-cell sprayed foam. Assemble multiple sections that are shipped loose with gaskets, caulk, and bolts per the manufacturer’s installation instructions.

B. External Casing:

1. Galvanized Steel: 18-gauge G90 with expanded foam injected insulation.

2. Pre-painted with a baked enamel finish passing 500-hour salt spray test (ASTM [American Society of Mechanical Engineers] B- 117) for pre-painted steel and 125-hour marine level 1 prohesion test (ASTM G-85.A5) for pre-painted steel.

C. Internal Casing:

1. Stainless Steel:

D. Roof:

1. Roof shall be double-wall, pitched in four directions at a minimum roof slope of 1/4-in. per foot across the width of the unit. No penetrations shall be made in pressure sensitive panels. Roof shall incorporate a standing top seam. All seams in the roof shall be gasketed and capped to prevent water infiltration into the unit.

E. Casing shall be supported by free-standing 16-gauge G90 structural frame with removable panels. Framing members shall have thermal break and injected with expanded foam insulation. Structural integrity of frame shall not be affected by removing panels. Top, bottom, and side panels shall be of one-piece double-wall construction, formed and reinforced to provide a rigid assembly. All panels shall be completely gasketed at factory with a minimum 1/4-inch-thick x 3/4 inch wide closed-cell neoprene. Top and side panels shall be easily removable for service.

F. Insulation: Glass fiber or Expanded Foam.

1. ‘K’ (Ksi) factor at 75 degrees Fahrenheit: Maximum 0.154 Btuh inch / sq. ft. / degrees Fahrenheit.

2. Density: Two (2) inch thick, minimum 1-1/2 lbs. /cu ft. throughout the entire unit. One (1) inch thick casing panels in any section is unacceptable.

3. If air unit structural frame comes into contact with conditioned air, it shall be insulated with the same material throughout the rest of the unit.

G. Access Section: Minimum 24” access section with minimum 18” door clearance of double wall galvanized steel construction for flush mounting, with gasket, latch, and handle assembly, same thickness as casing. Access door frame shall be extruded aluminum, foam filled with a thermal break barrier, and include a full perimeter gasket. All access doors shall match unit casing construction, include a thermal break. Provide access section between parallel coil sections, upstream of coil sections, upstream and downstream of the energy recovery wheels, in fan sections, filter sections, and mixing boxes.

H. Cooling Coil Drain Pan: Welded double wall, type 304 stainless steel IAQ pan with two (2) inch insulation and welded corners. Drain pans without welded corners are not acceptable. Cross break and pitch to drain connection. Cooling coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of coil. Intermediate pan shall have a minimum of two drop tubes to main pan. Drain pans shall allow no standing water and comply with ASHRAE Standard 62. Drain pans must be accessible for cleaning.

I. Strength: Furnish structure to brace casings for suction pressure of five (5) inch wg, with maximum deflection of 1 in 200.

2.5 FANS

A. Type: Refer to Air Handling Unit Schedule for fan type and drive type.

1. Supply Fans:

a. Direct drive plenum fans shall be single width single inlet type with backward inclined airfoil blades. Plenum fan wheel, airfoil blades and hub shall be constructed from aluminum.

B. Fan shall be statically and dynamically balanced at the factory as a complete fan assembly.

C. The Fan wheels shall be keyed to shaft to prevent slipping.

D. Construction: AMCA Class II.

E. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.

F. Sound Ratings: Tested to ARI 260 and label with Certified Sound Rating Seal.

G. Bearings: Provide permanently lubricated bearings.

H. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on slide rails. Furnish access to motor, drive, and bearings through hinged access doors. Mount base on vibration isolators with deflections in accordance with Section 15070.

I. Fan Modulation: Variable frequency drive.

J. Fan Motors: All motors shall be premium efficiency, NEMA MG-1Section 3, Inverter Duty. Refer to Specification 23 05 13 - Common Motor Requirements for HVAC Equipment for acceptable motor manufacturers.

2.6 BEARINGS AND DRIVES

A. Bearings:

1. Plenum fans shall have. Heavy duty pillow block style, self-aligning, regreasable roller type bearings selected for a minimum average life (L50) of 500,000 hours.

B. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated to prevent corrosion.

C. Motor Shaft Grounding Kit: For all AHU motors, a motor shaft grounding kit shall be provided. This shall be factory installed prior to shipment. If not available from the factory, the manufacturer is responsible for providing kits and field installation with no additional cost to owner or contractor.

D. Motor: Motor shall be non-overloading. Motor horsepower shall be sized at a point on fan curve resulting from 105 percent of design RPM at scheduled CFM with a reduction in static pressure of 0.5-inch wg. All fan motors shall be in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment

1. Motor Enclosure: Totally Enclosed Fan-Cooled (TEFC); ECM motors shall not be acceptable.

2. Provide (2) two forged motor lifting eyes and oversized conduit boxes with ground lugs.

3. 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.

4. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified

2.7 COILS

A. Provide access doors upstream and downstream of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank-offs and casing sealing grommets at connection penetrations. Coils shall be supported by stainless steel coil support members maintaining a minimum of 1” separation between bottom of coil casing and drain pan.

B. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

C. Water Heating Coils:

1. brazed joints.

2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

3. 18-inch access section between parallel coil faces.

4. Casing: Die formed channel frame of galvanized steel.

5. Tubes: 5/8-inch OD seamless copper, 0.020” thick, expanded into fins, brazed joints or 1/2-inch OD seamless copper, 0.025” thick, expanded into fins, brazed joints.

6. Fins: Aluminum, maximum of 12 fins per inch. Minimum fin thickness shall be 0.006” aluminum.

7. Coil supports shall be 16-gauge type 304 stainless steel.

8. Coils shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity

and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117-90. Field applied coatings will not be acceptable.

D. Water Cooling Coils:

1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.

2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.

3. Coils shall be a maximum of ten (10) rows deep.

4. 18-inch access section between parallel coil faces.

5. Casing: Die formed channel frame of 16-gauge type 304 stainless steel.

6. Drain Pans: Extend 12 inches downstream of coil and for coil banks more than 48 inches high provide intermediate pan with down spouts.

7. Tubes: 5/8-inch OD seamless copper, 0.020” thick, expanded into fins, brazed joints or 1/2-inch OD seamless copper, 0.025” thick, expanded into fins, brazed joints.

8. Fins: Aluminum, maximum of 12 fins per inch. Minimum fin thickness shall be 0.006” aluminum

9. Coil supports shall be 16-gauge type 304 stainless steel.

10. Coils shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117-90. Field applied coatings will not be acceptable.

E. Tube Velocities: Coil tube design velocity shall be a minimum of 3 feet per second and also maintain design water side temperature difference down to 30 percent flow through coil. Provide tubes that are enhanced internally if minimum initial design tube velocity cannot be obtained.

2.8 GERMICIDAL UVC EMITTERS - REQUIRED

Provide adequate space in the cooling coil section to allow for UVC Emitter installation and wiring and allow for a minimum 18” access door. Maintain full service.

A. UVC Emitters shall be provided for each Air Handling Unit and manufactured by Steril-Aire, Inc. only. UVC lights, including but not limited to safety switches and non-fused service disconnects, shall be field installed by local Steril-Aire factory authorized representative and not by mechanical contractor. A separate 120v/1ph electrical connection shall be provided by the electrical contractor.

B. Provide UVC Emitter in the same section as cooling coil immediately downstream of cooling coils and over drain pans; lights shall provide full coverage of cooling coils and drain pan. The UVC emitter shall be mounted inside the air handler casing a minimum of 12” downstream of cooling coil.

C. UVC Emitter and fixture shall be factory assembled and tested. Unit shall consist of housing, power source, reflector, emitter sockets, emitter, door safety switches and unit mounted disconnect for separate 120v / 1ph / 60 Hz power supply. Unit shall be constructed to withstand HVAC environments and shall be UL and CSA listed for damp locations.

Housing shall be constructed of hospital grade stainless steel and equipped with ½”conduit openings on each end to facilitate conduit nipple coupling fixture to fixture and wiring to power. Incorporate all components into one integral assembly that maximizes serviceability. Unit shall be designed to be mounted inside the air stream and downstream of the cooling coil.

The power source shall be a Class P2, rapid start type with a power factor of 0.99 and an efficiency of not less than 89%. Unit voltage shall be 120 and designed to maximize photon production, radiance, and reliability in cold or moving air streams of 35°-170°F. 100% RD and at any velocity and shall include RF and EMI suppression and Smart System – “End of Lamp Life” protection.

Reflector shall be constructed of heavy gauge aluminum alloy with a minimum 86% reflectance at 254 nm.

Sockets shall be medium bi-pin, double click safety, and twist lock type. They are constructed of a UVC resistant polycarbonate.

Emitter tube shall be high output, hot cathode, T5 diameter, medium bi-pin type that produces broadband UVC of 250 – 260 nm. Each tube shall produce the specified output at any airflow velocity and air temperature of 35°-170°F and produce no ozone or other secondary contamination.

Independent testing: When tested in accordance with the general provisions of IES Lighting Handbook, 1981 Application volume, output per 1” arc length is not less than 10µW/cm² at 1 meter in a 400-fpm airstream of 45° F.

2.9 AIR FILTRATION

A. Filter Box: Section with filter guides, access doors from both sides, for side loading with gaskets and blank-off plates.

B. Filter Frames: Pad holding frames shall be permanent metal frames designed to contain replaceable filter media pads. Frames shall be constructed of 22 gauge, galvanized steel U channel cell sides, expanded metal support grid, 9 gauge hinged retainer gate, sized to fit in standard universal holding frames, and accept maximum 2” thick media. Acceptable manufacturers: AAF or pre-approved equal.

C. Replaceable Filter Media: MERV 11 or greater rating in accordance with ASHRAE Test Standard 52.2-2007.

D. High Capacity Angle Filter: Two (2) inch extended area filters. Air quantities as scheduled, clean pressure drop of 0.10 inches wg; dirty pressure drop of 0.75 inches wg.

E. Filter Area: Max velocity of 350 FPM.

F. Provide list of each air handling unit with associated filter sizes to owner at substantial completion.

2.10 ROOF CURBS – PROVIDED BY RTU MANUFACTURER AND NOT "BY OTHERS"

A. Roof Curb shall be constructed of G90 galvanized steel and designed to mate with the down flow (confirm arrangement with plans) supply openings and provide support and a watertight seal. The roof curb design shall allow field-fabricated rectangular supply ductwork to be connected directly to the curb. Curb design shall comply with NRCA requirements. Curbs shall be shipped fully welded and insulated and include wood nailer strips.

B. Curbs shall be rated for a minimum of 155 mph and certified by structural engineer upon submittal. Certification shall be provided within submittal for approval.

C. Provide sound attenuation manufactured by **BRD HUSHCORE DS-53 Noise Control** System and shall be in full compliance with the following specifications:

1. The overall installed thickness shall be 14" for DS-49 products.

2. Shall meet Class "A" per ASTM E84 for flammability.

3. The composite panels shall get HUSH SEALANT™ model HSAC-100 acoustical grade caulk at seams and all perimeter edges inside the curb.
4. System shall be plenum rated.

5. The combination of all layers shall be tested for Sound Transmission Loss in accordance with procedure ASTM E-90-10. The assembly shall be rated at not less than STC-49 with 1/3 octave performance values as listed below for sound radiation through the deck inside the curb.

Freq. (Hz)	**80**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**	**STC**
TL (dB)	17	25	39	51	59	62	67	74	49

6. Copy of test report by an accredited lab shall be included in the submittals to document the above performance.

7. The mechanical contractor shall provide evidence of the in-curb acoustical treatment installation prior to lowering of the rooftop unit to the acoustical manufacturer. The acoustical manufacturer shall issue a letter of certification stating that the products have been properly installed and sealed around all ductwork and drops to eliminate air gaps which can compromise performance.

D. Comply with requirements in "The NRCA Roofing Manual."

E. Match roof curb to roof slope to provide level surface for RTU mounting.

F. Provide curb having vertical members insulated with a minimum thermal resistance (R-value) of 6.0 BTU/hr-ft2-°F or greater.
G. Provide curb with continuous insulation between unit base and roof curb. All walls are to be insulated with 2" fiberglass insulation; floor to be insulated with 1" fiberglass insulation.

H. Curb height shall be a minimum of 14".

I. All curbs shall be provided with minimum 12-gauge wind clips.

J. Roof Curb for Horizontal Airflow (where scheduled) - Horizontal openings in curb shall be custom designed for return and/or discharge for horizontal air handling. Opening size and location shall be indicated on drawings and/or schedule.

K. Provide wood nailing strip to which roofer may nail roof flashing.

L. Ship roof curb loose for field installation prior to unit placement.

2.11 OUTSIDE AIR DAMPERS

A. Outside Air and Economizer Damper Assembly: Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of Galvanized Steel. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq. ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 1 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return, enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood and adjustable barometric relief dampers.

B. Damper assembly shall be controlled by spring return, modulating actuator.

C. Once set, outdoor air dampers shall open to the minimum set position when indoor fan starts. The damper shall close to the full closed position when indoor fan shuts down.

D. Demand Control Ventilation: Provide a field installed and wired return air CO2 sensor to override the damper actuator to provide more outside air.

E. Bird Screen: Provide 1-inch aluminum mesh pre filter upstream of the outside air opening.

F. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.12 CONTROLS

A. Controls: Refer to Section 23 09 23 - Direct-Digital Control System for HVAC.

2.13 CAPACITY

A. Performance: Provide equipment as scheduled on Drawings.

2.14 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Provide equipment with electrical characteristics as shown on Electrical Drawings.

B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Requirements for motors.

C. Section 23 05 14 - Variable Frequency Controllers: Requirements for drives.

D. Combination Starter-Disconnect Switch: Provided by Division 26.

E. Junction Box: Factory provided, mounted, and wired junction boxes on each fan section. J-box shall allow electrical contractor to connect power to device without penetrating

through cabinet. Field installed J-boxes will not be acceptable; it shall be the complete responsibility of the manufacturer to install. Units shall be shipped with J-boxes pre-wired and mounted. Within equipment submittal the manufacturer shall show J-box location on plan view dimensional drawing.

F. Motor Overload Panel: For units with more than one fan, and to allow for a connection to a single variable frequency drive, provide a factory mounted and wired motor overload panel. Panel shall be UL listed, NEMA 3R enclosure with IECC manual starters with rotary type operators and auxiliary contacts.

G. All starters shall be equipped with integral phase-failure relay (automatic resetting type) to shut down motor upon loss of an electrical phase.

2.15 APPURTENANCES

A. For outdoor units, provide rain hood(s) with bird screens over openings.

2.16 FINISHES

A. Completely clean the exterior of AHU's prior to shipment.

B. Paint outdoor AHU's prior to shipment. Manufacturer shall apply a prime coat and finish coat of acrylic polyurethane in manufacturer's standard paint color or other owner approved color. The finished unit shall exceed 500-hour salt spray solution (5%) without any sign of red rust when tested in accordance with ASTM B-117.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with ARI 430.

B. Install assembled units with internal vibration isolators. Internally isolated fans shall be provided with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Contractor to provide fixed sheaves required for final air balance as dictated by Test and Balance Contractor.

D. Insulate coil headers located outside airflow as specified for piping. Refer to Section 23 07 19 - HVAC Piping Insulation.

E. Installation Hot Water Heating and/or Chilled Water Coil:

1. Make connections to coils with unions. Position unions to permit coil removal.

2. Connect water supply to leaving airside of coil (counter flow arrangement).

3. Locate water supply at bottom of supply header and return water connection at top.
4. Install water coils to allow draining and install drain connection at low points.

5. Install the following piping accessories on piping connections. Refer to Section 23 21 13 - Hydronic Piping
   a. On supply:
      1. Thermometer well and thermometer.
      2. Well for control system temperature sensor.
      3. Shutoff valve.
      4. Control valve.
      5. Pressure gage.
      6. Strainer
   b. On return:
      1. Thermometer well and thermometer.
      2. Well for control system temperature sensor.
      3. Pressure gage.
      4. Shutoff valve.
      5. Flow control valve.
6. Install valves and piping specialties in accordance with details as indicated on Drawings.
7. Install manual air vents at high points complete with shutoff valve. Refer to Section 23 21 13 - Hydronic Piping.
8. Install floor support stands at piping drops to air unit coil connections. Air unit coil shall not carry any suspended piping load.

F. Air unit manufacturer representative shall remove vibration isolation shipping blocks prior to start-up and ensure that fan base is free floating and isolators are not short circuited during operation.

G. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

H. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."

1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.
3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.

I. Suspended Units (Where Applicable): Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

J. Building Automation Systems Contractor shall provide and Install wall and duct mounted sensors with control wiring and make final connections to control devices and unit control panel.

K. Install separate devices furnished by manufacturer and not factory installed.

L. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

M. Install drainpipes from unit drain pans to approved drain.

1. Drain Piping: Drawn-temper copper water tubing complying with ASTM B 88, Type L (ASTM B 88M, Type B), with soldered joints.

    1. Pipe Size: Same size as condensate drain pan connection.
    2. Insulate condensate piping according to section 23 07 19 HVAC Piping Insulation.

2. Unless noted otherwise provide rooftop portable pipe supports in 6’-0” maximum intervals. Roof supports shall be manufactured by Advanced Support Products (ASP), model REC-SA (Rubber EcoCurb) with channel or approved equal. Product specifications:

    1. Bases: 100% recycled Vulcanized Rubber with UV inhibitors.
    2. Weight: Base with assembly 9.5 pounds
    3. Dimensions: 9” x 6” x 4”
    4. Height: Adjustable
    5. Hot dipped galvanized threaded rods, nuts and washers

3.2 CONNECTIONS

A. Coordinate installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

B. Where installing piping adjacent to units, allow space for service and maintenance.

C. Hydronic Piping Connections:

1. Comply with requirements in Section 23 21 13 "Hydronic Piping."

2. Install shutoff valve and union or flange on each supply connection and install balancing valve and union or flange on each return connection.

D. Duct Connections:

1. Comply with requirements in Section 23 31 13 "Metal Ducts."

2. Drawings indicate the general arrangement of ducts.

3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 23 33 00 "Air Duct Accessories."

E. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.

2. Charge refrigerant coils with refrigerant and test for leaks.

3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Verify that shipping, blocking, and bracing are removed.

3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.

4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.

6. Verify that zone dampers fully open and close for each zone.

7. Verify that face-and-bypass dampers provide full face flow.

8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.

9. Comb coil fins for parallel orientation.

10. Verify that proper thermal-overload protection is installed for electric coils.

11. Install new, clean filters.

12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.

3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.6 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units externally and internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, comb coils, drain pans, and filter housings, and install new, clean filters.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

3.8 PROTECTION OF FINISHED WORK

A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

B. All air units shall remain in manufacturer’s protective shipping wrap during construction. Air unit casing openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

END OF SECTION 23 74 13.16

SECTION 23 81 26 - DUCTLESS MINI-SPLIT-SYSTEM AIR-CONDITIONERS

PART I -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

A. Indoor, wall or ceiling mounted, direct-expansion fan coils are matched with cooling only outdoor unit.

B. Outdoor air-cooled split system compressor sections suitable for on-the-ground, rooftop, wall hung or balcony mounting. Units shall consist of a rotary compressor, an air-cooled coil, propeller-type draw-through outdoor fan, metering device(s), and control box. Units shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling only or heat pump system (refer to schedule).

C. Indoor unit shall be rated per ARI Standards 210/240 and listed in the ARI directory as a matched system.

D. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed locally at fan coil controller shall be available through building automation system.

E. Outdoor unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC. Units shall be evaluated in accordance with UL standard 1995. Units shall be listed in the CEC directory. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061). Air-cooled condenser coils shall be leak tested at 573 psig.

F. Provide equipment with electrical characteristics as shown on the Electrical Drawings.

1.3 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Mitsubishi.
2. Fujitsu.
3. LG.

1.4 SUBMITTAL:

A. Submit in form similar to the schedule on the Drawings. Show all data listed in schedule, electrical characteristics and accessories being provided.

B. Provide line-by-line specification review annotated to certify compliance or deviation.

C. General: Submit listed submittals in accordance with Conditions of the Contract and

Division 1 Submittal Procedures.

D. Product Data: Submit product data, including manufacturer's □product sheet for specified products.

1.5 WARRANTY

A. One (1) year on unit parts other than compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.

B. Five (5) years on compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.

C. One (1) year on refrigerant and oil. Warranty shall begin from date of Certificate of Substantial Completion.

PART 2 –PRODUCTS

2.1 UNIT CABINET:

A. Indoor unit cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.

B. Outdoor unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish on inside and outside. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.

C. Indoor and outdoor unit shall be of the same manufacturer.

2.2 COMPRESSOR

A. Compressor shall be fully hermetic rotary type. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators.

2.3 COIL

A. Evaporator coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.

B. Condenser coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.

2.4 FANS

A. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided standard. Air sweep operation shall be user selectable. The vertical sweep may be adjusted (using the remote control) and the horizontal air direction may be set manually.

2.5 AIR FILTERS

A. Unit shall have filter track with factory-supplied cleanable filters.

2.6 BUILDING AUTOMATION SYSTEM INTERFACE:

A. Controls shall consist of a microprocessor-based control system which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 62° F to 84°F.

B. The unit shall have integral controls provided by unit manufacturer to perform input functions necessary to operate the system. Factory installed hardware and software to enable building automation system to monitor, control, and display status and alarms.

1. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed locally at fan coil controller shall be available through building automation system.

2. The unit shall be compatible with interfacing with connection to BACnet networks or interfacing with connection to BMS system.

C. The unit shall have the following functions as a minimum:

1. An automatic restart after power failure at the same operating conditions as at failure.

2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.

3. Temperature-sensing controls shall sense return air temperature.

4. Indoor coil freeze protection.

5. Wireless infrared remote control to enter set points and operating conditions.

6. Automatic air sweep control to provide on or off activation of air sweep louvers.

7. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.

8. Fan-only operation to provide room air circulation when no cooling is required.

9. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.

10. Fan speed control shall be user-selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.

11. Automatic heating-to-cooling changeover in heat pump mode. Control shall include dead band to prevent rapid mode cycling between heating and cooling.

12. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.

PART 3 -EXECUTION

3.1 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.

2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.

3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

3.2 STARTUP SERVICE

A. Refer to Section 23 05 93 Testing, Adjusting, and Balancing for HVAC.

3.3 CLEANING

A. Clean units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing fan coil and air-distribution systems clean filter housings and install new filters.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 23 81 26

SECTION 23 82 39.19 - ELECTRIC UNIT HEATERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electric Unit Heaters.

B. Related Sections:

1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers for placement by this section.

2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

1.3 REFERENCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.

2. ASHRAE 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.

B. Underwriters Laboratories Inc.:

1. Units to be UL Listed.

1.4 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.

2. Location and size of each field connection.

3. Details of anchorages and attachments to structure and to supported equipment.

4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.

5. Location and arrangement of integral controls.

6. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.

2. Structural members to which unit heaters will be attached.

3. Method of attaching hangers to building structure.

4. Size and location of initial access modules for acoustical tile.

5. Items penetrating finished ceiling, including the following:

6. Lighting fixtures.

   a. Air outlets and inlets.
   b. Speakers.
   c. Sprinklers.
   d. Access panels.

7. Perimeter moldings for exposed or partially exposed cabinets.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of thermostats or other products not mounted on unit.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept heaters and controls on site in factory packaging. Inspect for damage.

1.9 WARRANTY

A. Furnish a five (5) year manufacturer warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start-up will not be acceptable.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Reznor
2. Markel
3. Raywall
4. Redd-i
5. Qmark

B. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, controls, and accessories complying with ARI 440:

1. Discharge Louvers: Individually adjustable horizontal and vertical louvers to match cabinet finish.

2. Control Voltage: 24-volt, 60 hertz

3. Wall mounted adjustable thermostat.

4. Location: Suspended overhead.

5. Comply with UL 2021.

C. Cabinet: 18-gauge steel with baked enamel finish, easily removed and secured access panels, insulated or double panel construction.

D. Supply Fan: Propeller type with direct drive, dynamically balanced and mounted with rubber vibration insulators.

E. Heat Exchanger: High mass, all steel tubular finned type, copper brazed elements.

F. Controls: Wall mounted Thermostat with fan switch.

G. Motor: Totally enclosed industrial rated. Motor on units to 20KW shall utilize sealed bearings. Motor on units larger than 20KW shall be 2-speed, permanent capacitor-type, continuous duty.

H. Wiring:

1. Sub-divided circuits with individual fuse protection

2. Internal 24V control transformer.

3. Heavy duty magnetic contactors.

4. Thermal cutouts on control circuit with automatic reset.

5. Low voltage thermostatic kit with fan switch.

6. Factory wired disconnect switch.

7. Performance: Provide equipment as scheduled on Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cabinet unit heaters to comply with NFPA 90A.

B. Install unit heaters level and plumb.

C. Suspend cabinet unit heaters from structure with elastomeric hangers. Refer to Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Comply with safety requirements in UL 1995.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 23 82 39.19

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide all work for electrical systems required in the project to be properly installed, tested and performing their intended function.

1.3 QUALITY ASSURANCE

A. Perform all work in accordance with the latest edition of the national electrical code, and local codes.

B. All electrical materials and distribution, and utilization equipment shall be UL Listed.

C. All equipment and materials shall be new and unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.

D. Eliminate any abnormal sources of noise that are considered by the architect not to be an inherent part of the electrical systems as designed.

1.4 COORDINATION WITH OTHER TRADES

A. Coordinate the work of this division with all other divisions to ensure that all components of the electrical system will be installed at the proper time and fit the available space.

B. Locate and size all openings in work of other trades required for the proper installation of the electrical system components.

C. Make all electrical connections to all equipment furnished by this division and any other division.

D. Make all electrical connections from all 120 volt and greater dampers and switches to associated exhaust fan(s) furnished by any other division.

1.5 DRAWINGS

A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the electrical equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that Contractor proposes to furnish will fit in the space. The

drawings are not intended to show exact locations of conduit and wire, or to indicate all wire terminators, connectors, conduit fittings, boxes or supports, but rather to indicate distribution, circuitry, and control.

B. The Electrical Drawings are necessarily diagrammatic in character and cannot show every connection in detail or conduit in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed conduit is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.6 SUBMITTALS

A. Specification Review:
1. Include a paragraph-by-paragraph written specification review for each product listed requiring a submittal. Denote any proposed deviations from specifications.

1.7 EXISTING CONDITIONS

A. Do all work required to maintain electrical services to the Owner occupied portions of the building during construction.

B. No connection to existing services or utilities shall be made without Owner's knowledge and permission. All such connections shall be planned and scheduled to minimize the length of service interruption required. Request for shutdown shall be made to Owner at least two (2) weeks in advance and shall be accompanied by detailed written schedule of activities during shutdown and list of materials required for connection and renewal of service. It shall be understood that all such service interruptions shall be made at the Owner's convenience, not the Contractor's. No increase in contract amount will be allowed for reasons of premium time, inefficiency of operations or other considerations not calculated in original bid.

C. All items removed shall be stored on-site. Schedule a review of the items with the Owner. Remove from site all items the Owner does not choose to keep. Deliver Owner designated items to Owner's storage facility.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

A. Provide allowance in bid for twenty-five 20A/1p circuits of 100 feet in length from source for miscellaneous needs during the course of construction. Include one duplex receptacle per circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.

B. Provide allowance in bid for twenty-five light switching circuit drops of twenty feet in length for miscellaneous needs during construction. Include one 277V light switch per circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.

C. Provide allowance in bid for ten additional exit signs for miscellaneous needs during construction. Include circuiting, all associated labor and all necessary accessories required for proper installation.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Provide temporary wiring and connections to maintain existing systems in service during construction.

C. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.

D. Remove, relocate, and extend existing installations to accommodate new construction.

E. Repair adjacent construction and finishes damaged during demolition and extension work.

3.2 OWNER INSTRUCTION

A. Provide on-site Owner training for all new equipment.

B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.

C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide a complete system of building wire and cable to all electrical loads.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:
   1. Provide stranded conductors for all wiring.
   2. Conductor not smaller than 12 AWG for power and lighting circuits.
   3. Conductor not smaller than 16 AWG for control circuits.
   4. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet
   5. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
   6. Copper.

B. Wiring Methods: Provide the following wiring methods:
   1. Concealed Dry Interior Locations: Use only Type THHN/THWN insulation, in raceway.

C. Branch Circuit Conductors: No branch circuit conductors are allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 COORDINATION

A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers:
   1. Diamond Wire & Cable Co.
   2. Southwire
   3. General Cable Co.

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation: NFPA 70; Type THHN/THWN insulation for feeders and branch circuits.

2.2 TYPE AC CABLE

A. Manufacturers:
   1. AFC
   2. Southwire

B. Product Description: A fabricated assembly of insulated conductors in a flexible metallic enclosure.

C. Comply with NEC 320.

D. Support, provide separate support to structure for all Type AC cable, spacing not exceeding three (3) feet and at each junction box.

E. Provide an insulated green grounding conductor in all Type AC cable.

F. Acceptable Use: Install, at Contractor's option, only for service to light fixtures above accessible ceilings, limit length to six (6) feet whips from accessible junction box to light fixtures.

G. Provide insulated throat fittings at all terminations of Type AC cable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify interior of building has been protected from weather.

B. Verify mechanical work likely to damage wire and cable has been completed.

C. Verify raceway installation is complete and supported.

3.2 EXISTING WORK

A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.

B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.

C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.

D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

A. Route wire and cable to meet Project conditions.

B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

C. Identify and color code wire. Identify each conductor with its circuit number or other designation indicated.

D. Special Techniques - Wiring Connections:
1. Clean conductor surfaces before installing lugs and connectors.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
   a. MDF/IDF room branch circuits: All branch circuits shall be dedicated and unspliced. Provide dedicated branch circuit 20 or 30 amperes, #10 and or #12 wire, unspliced from wiring device all the way back to the overcurrent device. Do not share ground with any other circuit.
   b. Computer branch circuits: All branch circuits shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral with any other circuit.
   c. Kitchen branch circuits: All branch circuits for 125 volt, single phase, 15 and 20 ampere receptacles shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral or ground with any other circuit.
3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.4 WIRE COLOR

A. COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

	Wire Sizes #10 and Smaller: Use Continuous Color Coded Insulation (Note 01)				**Wire Sizes #6 and Smaller: Use Continuous Color Coded Insulation (Note 02)**	
System/Phase	**A**	**B**	**C**	**N**	**G**	**IG**
120/208	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240	Black	Orange	Blue	White w/color stripe (Note 03)	Green	Green/Yellow Stripe
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Table Notes:

1. Wire size #8 and larger, black conductors with color marking tape at each termination and where accessible; colors as noted above.
2. Wire sizes #4 and larger, black conductor with green marking tape at each termination and where accessible.
3. Provide white (no stripe) insulation when 120/208V system is not present at this installation.

B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number and provide color coding at each junction box containing more than one neutral.

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:
For 6 AWG and smaller: Green.
For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 GROUPING OF CIRCUITS

A. Limit the number of current carrying conductors per conduit to 6. Neutrals serving computer receptacle branch circuits shall be counted as current carrying. Grounds shall not be counted.

B. Grouping of different voltages is not allowed.

C. Provide metal box sizes per NEC Table 314.16 (A).

D. Provide conduit per NEC Annex C.

E. Neutrals serving branch circuits shall not be shared. Provide dedicated neutral per circuit.

3.6 POWER LIMITED CIRCUIT INSTALLATION

A. Provide a complete system of raceway and covered junction boxes for all power limited circuits installed exposes in finished spaces and spaces without a ceiling.

B. Provide raceway for all power limited circuit wiring within wall cavities and above sheet rock, plaster and other “hard” (non-lay-in) ceiling types of construction.

C. Labeling: Provide label on all junction boxes.
1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the system wiring name.

END OF SECTION 23 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide a continuous low-impedance grounding system for the entire electrical wiring system.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
   2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. NFPA 70 - National Electrical Code.

1.4 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:
   1. Metal underground water pipe.
   2. Metal building frame.
   3. Concrete-encased electrode.
   4. Ground ring.
   5. Rod electrode.
   6. Plate electrode.

1.5 SUBMITTALS

A. Product Data: Submit data on grounding electrodes and connections.

1.6 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.7 GROUND RING PRE-INSTALLATION MEETINGS

A. This paragraph shall apply to buildings when a ground ring is specified.

B. Convene minimum one (1) week prior to commencing work of this section.

C. Coordinate with concrete pour schedule for footings to insure rebar in concrete is available for bonding.

1.8 MADE ELECTRODE INSPECTION

A. Convene prior to cover up of work of this section.

B. Coordinate inspection of made electrode, exothermic welds and test well installation.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

A. Manufacturers:
1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. O-Z Gedney Co.
5. Thomas & Betts
6. VFC

B. Product Description:
1. Material: Copper-clad steel
2. Diameter: 3/4 inch
3. Length: ten (10) feet

2.2 WIRE

A. Material: Stranded copper.

B. Foundation Electrodes: #2 AWG.

C. Grounding Electrode Conductor: Copper conductor bare.

D. Bonding Conductor: Copper conductor bare.

2.3 MECHANICAL CONNECTORS

A. Manufacturers:
1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. ILSCO Corporation
5. O-Z Gedney Co.
6. Thomas & Betts, Electrical
7. VFC

B. UL Listed for grounding applications.

C. Provide “ACORN” style ground clamp only for all driven ground rods unless noted to be exothermic connected in this specification. UL listed for connecting ground conductor to a driven ground rod.

D. Description: Brass connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

A. Manufacturers:
1. Cadweld by Erico, Inc.

B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.5 GROUNDING BUSSES

A. When indicated, provide copper ground busses on walls in areas where special grounding needs will arise. Bus shall consist of copper bar as follows:
1. Ground bar cross section of nominal four (4) inches by 1/4 inch; 24 inches length.
2. Drill to accommodate NEMA Pattern D 2-hole compression lugs for ground wires to be installed. Leave remainder of bar for future drilling by owner.
3. Copper compression lugs to connect conductors to the bar. Lugs shall be 2-hole type for double bolting to ground bar.
4. Install all bolts for compression with top and bottom steel washers plus a Belleville spring washer between top washer and bolt head.
5. Grounding electrode conductor(s) shall be fusion-welded on buss (and not lugged on).
6. Mounting Free air, no enclosure required. Install Harger WBKT-1 brackets to mount bar to wall. Isolate copper bar from mounting brackets with Harger 4200-Seriess two (2) inch insulators.
7. Fasten clear pexiglass cover on standoff bolts over ground bar. Engrave cover "GROUND BUS". Cover by Harger Lightning Protection, Inc., or approved equal.
8. Ground bar assembly shall be Harger Lightning Protection, Inc. GBI Series (800-842-7437, www.harger.com), Erico, Inc. (800-248-9353) or approved equal.

2.6 DRIVEN ELECTRODE ACCESS WELL AND COVER

A. Eight (12) inch diameter concrete pipe with belled end.

B. 24 inches long or longer to reach ground and set flush in grade.

C. Provide cast iron cover with "GROUND" embossed on top.

PART 3 – EXECUTION

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DELETE FOR REMODEL

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3.1 EXAMINATION

A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

A. Modify existing grounding system to maintain continuity to accommodate renovations.

B. Extend existing grounding system using materials and methods compatible with existing electrical installations.

3.4 INSTALLATION

A. Install in accordance with NEC Article 250. Properly bond the system neutral to the system grounding electrode conductor at the main service entrance equipment. Route the grounding electrode conductor to, and bond to, the grounding electrode system. All other neutral busses, bars, etc. on the service voltage system shall be isolated from ground. This system shall be the solid grounded type.

B. Bond all ground electrodes together to form the grounding electrode system including metal underground water pipe, metal frame of the building or structure, concrete encased electrodes, ground ring, rod and pipe electrodes and plate electrodes.

C. Install grounding and bonding conductors concealed from view.

D. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.

E. Install a green equipment grounding conductor in all feeders and branch circuits, minimum size per NEC Table 250.122.

F. Transformers: Ground as a separately derived source.
1. Where transformer secondary includes a neutral, the neutral shall be bonded to the equipment enclosure and connected to the system ground conductor.
2. Size bonding jumper per NEC Table 250.66.
3. Grounding conductor shall be in raceway and shall be bonded to nearest available point of interior metal water piping system.

G. Concrete-Encased Electrode (NEC 250-52):
1. Concrete-encased electrode is also known as the "Ufer ground". Concrete footings or foundation that are in direct contact with the earth and located at the building periphery shall be made available for use as electrodes. Designated footings shall be used for grounding purposes. Unless other wise noted on drawings, designated footings are the perimeter building corners plus perimeter footings approximately on 100 feet centers between corners.

H. Made Electrode:
1. Triple Ground Rod: Provide a building ground rod and bond it to the electrode system. The building ground rod shall consist of three ground rods, arranged in an equilateral triangular pattern located at least five (5) feet outside an exterior building wall or as otherwise directed. Space 15 feet apart and drive into the earth to a point two (2) feet below finished grade to top of rods. Grounding

electrode conductor shall form a continuous loop around rods, and conductor shall be properly bonded to each rod by a fusion weld similar to "Cadweld".

2. Extend grounding electrode conductor from this ground rod(s) to the grounded service conductor (neutral) in the building main switchboard at an accessible point on the ground bus per NEC 250-24.
3. Install grounding electrode conductor of 3/0 Copper.

I. Main Bonding Jumper: Shall be sized in accordance with Section 250-66, if not indicated on the drawings, and installed within the same enclosure as the point of bonding of the system neutral service entrance.

J. Grounding Busses:
1. Provide a copper bus bar where indicated on Drawings. Provide grounding electrode conductor and connection to the grounding electrode system. AWG No. 2 minimum.
2. Provide in each IDF and MDF room.
3. Provide at each CATV / MATV head-end mounting board.
4. Provide at each building communications rack.
5. Provide at each sound reinforcement equipment rack.

K. Water Pipe Electrode: A ten (10) foot minimum length of electrically continuous underground metal water pipe. Bond around insulating joints or sections, insulating pipe, and water meters to make pipe electrically continuous.

L. Metal Building Frame NEC 250-52.
1. The structural steel or other metal frame of the building. Effectively ground the steel structural columns to the ground ring electrode.
2. Cadweld AWG #2 bare copper cable to base of steel column. Route bonding jumper down through column blockout in building floor slab, excavate under grade beam, and extend out to the ground ring. Cadweld jumper (also called "stinger") or install Burndy Hyground™ Type YGHP-C hydraulic compression connector onto ground ring. Install a ground rod at each point where a stinger from a building steel column lands on the ground ring.

M. Ground Ring Electrode (NEC 250-52):
1. Provide a tinned, bare copper conductor, size AWG #2 or larger, ground loop in direct contact with the earth. Install around and below the entire periphery of the building at least 36 inches underground. The ring conductor shall be in direct contact with the earth and below any concrete mat or seal slab that may be part of the building structural foundation. Bond this ground ring to all other electrodes and to the grounded service conductor (neutral) in the building main switchboard at a point on the supply side of each service disconnect.

N. Fuel Gas Piping:
1. Each above ground portion of a gas piping system upstream from the equipment shutoff valve shall be made electrical continuos and bonded to the building grounding electrode system, as required in NFPA 54, National Fuel Gas Code.
2. Gas piping shall not be used as a grounding electrode.

O. Engine Generator Neutral:
1. Ground the generator neutral as a separately derived system per NEC 250-20(d).
2. Sign: Provide a sign at the service entrance equipment indicating type and location of on-site generator.

P. Outdoor Lighting Poles:

1. All metallic outdoor poles and luminaries on metallic or non-metallic lighting poles shall be grounded by bonding in an approved manner to the circuit grounding conductor. In addition to this, bond pole to a #8 bare copper wire which shall also be bonded to a ground rod. Install the ground rod adjacent to the pole base with the top driven at least two (2) feet below grade.

3.5 OTHER GROUNDING SYSTEMS:

A. General Check the drawings for special grounding system or grounding requirements.

B. Telephone and data equipment grounding connections:
1. Bond each telephone and data equipment ground (buss type or grounding conductor type) at each telephone terminal board and data rack back to the service entrance grounding electrode system with a bare #6awg ground wire.

3.6 EQUIPMENT GROUNDING SYSTEM

A. General: Make a firm bond between all enclosures, equipment and metallic raceway system. Grounding conductors shall be continuous from origin to termination and properly bonded with lugs at both ends. The metallic raceway systems shall be made up properly to form a grounding path that has an impedance back to the main system ground that is as low as can be practically obtained.

B. Over 250 Volts: Provide locknuts and/or listed fittings per NEC 250-97 for bonding of metal raceways in all circuits of over 250 Volts to ground. In case of oversized, concentric or eccentric knockouts, comply with NEC 250-92(B). The use of snap-in, wedge-type, or pivot-type connectors is prohibited.

3.7 FIELD QUALITY CONTROL

A. Grounding Tests:
1. Test the electrical system after installation is complete. Inspect and test for stray currents, unintended ground shorts, and proper physical condition of grounding system. Correct any deficiencies and re-test to verify satisfactory installation.
2. Provide written test report to document all findings, test values, work done and certification of grounding system.
3. Use true-RMS meters for all voltage and current measurements.
4. Test telecommunications grounding riser to verify continuity.
5. Check all isolated ground receptacles for correct polarity.
6. Test all sub panels of separately derives systems to verify subpanel neutral is isolated from ground.
7. Test theater isolated power system for the sound reinforcement system to verify isolation of ground system from other building systems.
8. Verify continuity and isolation of audio system ground bus and grounding riser.
9. Perform ground resistance and continuity testing in accordance with IEEE 142.
10. When improper grounding is found on receptacle, check receptacles in entire project and correct. Perform retest.

3.8 TEST WELLS

A. Install test well for designated outdoor driven ground rods. Set tops of well flush with finished grade. Provide mechanical connector for ground rod inside test well so that rod can be disconnected from ground ring or other grounding electrode system for testing.
   1. Designated Ground Rods:
      a. One (1) at triple ground rod for High School Main Switchboard Electrical Room.
      b. One (1) at each generator.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to electrical work.
7. Firestopping accessories.
8. Equipment bases and supports.

1.3 REFERENCES

A. Underwriters Laboratories Inc.:
1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL - Fire Resistance Directory.

1.4 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to Building Code and UL for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

A. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with the Building Code.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. Electroline Manufacturing Company
3. O-Z Gedney Co.
4. Appleton

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. B-Line Systems
3. Midland Ross Corporation, Electrical Products Division
4. Unistrut Corp.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

A. Sleeves for raceway Through Non-fire Rated Floors: 18 gage galvanized steel.

B. Sleeves for raceway Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.

C. Sleeves for raceway Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL Listed.

D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 SPRING STEEL CLIPS

A. Product Description: Mounting clamp, and screw.

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline Link-Seal, Inc.
2. NMP Corporation

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

A. Manufacturers:
1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products .
6. Specified Technology, Inc.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

A. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

B. General:
1. Furnish UL Listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

C. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:
   1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors or preset inserts as required.
   2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners or welded fasteners as required.
   3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors as required.
   4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts or hollow wall fasteners as required.
   5. Solid Masonry Walls: Provide expansion anchors or preset inserts as required.
   6. Sheet Metal: Provide sheet metal screws.
   7. Wood Elements: Provide wood screws.

B. Inserts:
   1. Install inserts for placement in concrete forms.
   2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four (4) inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to suspended ceiling support system, pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:
   1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
   2. Install surface mounted cabinets and panelboards with minimum of four anchors.
   3. In wet and damp locations install steel channel supports to stand cabinets and panelboards one (1) inch off wall.
   4. Support vertical conduit at every floor.

3.3 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place intumescent coating in sufficient coats to achieve rating required.

F. Remove dam material after firestopping material has cured.

G. Fire Rated Surface:
1. Seal opening at all rated floors and walls as follows:
a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
c. Pack void with backing material.
d. Seal ends of sleeve with UL Listed fire resistive silicone compound to meet fire rating of structure penetrated.
2. Where cable tray, bus, or conduit, penetrates fire rated surface, install firestopping product ins accordance with manufacturer's instructions.

H. Non-Rated Surfaces:
1. Seal opening through non-fire rated floors and walls as follows:
a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
c. Install type of firestopping material recommended by manufacturer.
2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries: Provide mechanical sleeve seals.

B. Interior conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors and walls one (1) inch above finished floor level. Caulk sleeves.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes, and handholes.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
   2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
   3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

B. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
   3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
   4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
   5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
   7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal junction and pull boxes. Provide flush mounting outlet box in finished areas.

C. Concealed Dry Locations: Provide rigid steel intermediate metal conduit on electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

D. Exposed Dry Locations: Provide rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

E. In Slab or Under Slab on Grade: No branch circuit raceway is allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

B. Protect PVC conduit from sunlight.

1.6 COORDINATION

A. Coordinate installation of outlet boxes and raceway for equipment connected under other Divisions.

B. Coordinate installation of conduit for control wiring in mechanical rooms and in inaccessible locations such as walls and hard ceilings.

C. Coordinate installation of conduit for all other low-voltage systems in inaccessible locations and all other locations required by drawings or specifications for those systems.

D. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes. Refer to Architectural elevations and equipment specifications and coordinate device locations prior to electrical rough-in.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:
1. Carlon Electrical Products
2. Hubbell Wiring Devices
3. Thomas & Betts Corp
4. Walker Systems Inc.
5. The Wiremold Co.
6. Multi Cell
7. O-Z Gedney
8. Raco.
9. or approved equal.

B. Rigid Steel Conduit: ANSI C80.1.

C. Intermediate Metal Conduit (IMC): Rigid steel.

D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit

E. Electrical Metal Tubing (EMT): All EMT fittings shall be steel not die-cast metal. All conduit stub-ups above ceiling for low voltage and data to be provided with insulating bushing.

F. Flexible Metal Conduit (Flex): Conduit fittings shall be steel. Provide plastic anti-short bushing for all flex fittings. Comply with NEC 348.

G. Liquidtight Flexible Metal Conduit: Shall be same as flexible metal conduit specified above except Article 350 in NEC.

H. PVC-Coated Rigid Steel Conduit: Galvanized rigid steel with additional external coating for 40 mil polyvinyl chloride jacket (PVC). Conforming to UL Standard 6. ANSI C80.1 and NEMA Standard No. RN.1.
   1. Manufacturer:
      a. Ocal Inc.
      b. Perma Cote Industries
      c. Rob-Roy Industries
      d. or Approved equal.

I. PVC-Rigid Nonmetallic Conduit: PVC and fittings that are listed per the UL Standards. Comply with NEMA Standard TC-2.

J. Nonmetallic Multi Duct: Provide nonmetallic multi duct that is UL Listed.
   1. Type: four (4) inches schedule 40 PVC outer duct, four 1.25 inch ducts of ribbed polyethylene. Duct shall have six (6) inch deep end bell on one end, spigot on the other end.
   2. Multi Duct shall have gaskets to seal the inside and outside walls of the inner duct.

2.2 ENCLOSURES

A. Pull Boxes, Junction Boxes, Cabinets, and Wireways: Provide pull boxes, junction boxes, wireways, and cabinets wherever necessary for proper installation of various electrical systems according to the National Electrical Code and where indicated on the Drawings.

B. Minimum Size: That size shown on the drawings, as required for the specific function, or as required by the National Electrical Code, whichever is larger.

C. Construction:
   1. Indoors in Dry Areas and Not Buried in Slab: Code gage steel - NEMA 1 construction - sides formed and welded, screw covers unless indicated hinged cover or door on drawings. Hinged doors shall be similar to panelboard doors with the same type locking device. Knockouts shall be factory made or formed O-Z Gedney Type PB or approved equal.
   2. Outdoors or Indoors in Wet Areas and Not Buried in Slab: Same as specified above for indoor except provide NEMA 3R (designated by 3R or RT) unless indicated or specified to be NEMA 4 (designated by 4 or WP) or other type rating.
   3. Indoors Buried in Slab: Watertight, galvanized cast iron in floors on or below grade, otherwise concrete tight stamped steel.
   4. Outdoors Buried in Earth: Watertight, Polymer concrete similar to Hubbell Power System, Inc. “Quazite” or precast concrete type manufactured by Brooks Product, Inc brand for Oldcastle Precast, Inc. Precast box shall have appropriate structural rating for intended use. Install on a level poured concrete base to provide a solid bearing surface. Provide a bolted cast iron traffic cover with foundry-cast marking "Electrical", "Communications" or "Telephone" as applies.

Top of enclosure shall be one (1) inch above finished grade in earth. Top of enclosure shall be flush with finished pavement.

2.3 WIREWAY

A. Manufacturers: Same as Metal Conduit.

B. Product Description: General purpose.

C. Size: As determined by Contractor in accordance with NEC 376.

D. Cover: Screw cover.

E. Connector: Slip-in.
F. Fittings: Lay-in type.

G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.4 OUTLET BOXES

A. Manufacturers: Same as Metal Conduit.

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

C. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer.

D. Wall Plates: As specified in Section 26 27 26.

2.5 FLOOR BOXES

A. UL listed for wet application, watertight cast-iron.

B. NEMA OS-1, sheet steel outlet boxes, device boxes, covers, and box supports.
1. Floor: Fully adjustable before and after pour.
2. UL Listed for wet application when installed into concrete, stone, tile or floor without carpet cover. Provide carpet flange where installed in carpet.
3. Provide watertight, cast iron on floors at or below grade, and provide concrete tight stamped steel on all upper floors.
4. Multi Gang Floor Box: Fully adjustable watertight cast iron gang floor boxes where shown on Drawings. Provide with removable partition and provide conduit openings in boxes as required. Install power circuits in separate raceway from data, telephone or other signal.

C. Manufacturers:
1. Appleton
2. Carlon
3. Crouse-Hinds
4. Hubbell
5. Thomas & Betts / Steel City
6. Walker

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.

D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.

F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION - RACEWAY

A. Ground and bond raceway and boxes in accordance with Section 26 05 26.

B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 25 29.

C. Identify raceway and boxes in accordance with Section 26 05 53.

D. Arrange raceway and boxes to maintain headroom and present neat appearance.

E. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

F. Arrange raceway supports to prevent misalignment during wiring installation.

G. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

H. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.

I. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

J. Do not attach raceway to ceiling support wires or other piping systems.

K. Construct wireway supports from steel channel specified in Section 26 25 29.

L. Route exposed raceway parallel and perpendicular to walls.

M. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

N. Maximum Size Conduit in Slab Above Grade: 3/4 inch.

O. Maintain clearance between raceway and piping for maintenance purposes.

P. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees Fahrenheit.

Q. Cut conduit square using saw or pipe cutter; de-burr cut ends.

R. Bring conduit to shoulder of fittings; fasten securely.

S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

T. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. DO NOT route conduit through the top of any outdoor disconnects, panels, etc. conduits must be routed through side or bottom only.

U. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than two (2) inch size.

V. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

W. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.

X. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

Y. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

Z. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

AA. Close ends and unused openings in wireway.

BB. Provide tracer wire on all underground raceway outside building slab on grade.

3.4 RACEWAY TYPES

A. The following raceway types are to be used in the following locations:
   1. Under Slab on Grade: Schedule 40 PVC.
   2. Outdoor Locations, Above Grade: Rigid galvanized steel.
   3. Wet and Damp Locations: Rigid galvanized steel.
   4. Exposed or Concealed Dry Locations, Indoors: EMT, IMC, or rigid galvanized steel.
   5. Underground:
      a. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 208 volts or greater shall be encased in red concrete two (2) inches thick on all sides. Encasement not required under building slabs, parking lots or other paved surfaces. Red dye may not be applied to the top of the concrete.

b. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 120 volts or less shall have red warning tape 6” above raceway.

6. Transformers and Motors: 24 inch flexible metal conduit to equipment.
7. Kitchens and outdoor motor and transformer connections: Liquidtight flexible metal conduit for all exposed raceway.
8. Cooling Towers: PVC coated rigid galvanized steel within 50 feet of tower.

3.5 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as approved by the Architect.

B. Adjust box location up to ten (10) feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented as specified in Section 126 27 26.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

F. Do not fasten boxes to ceiling support wires or other piping systems.

G. Support boxes independently of conduit. Provide rigid support to structure for all junction boxes. Mount junction boxes within 18” of finished ceilings to facilitate future access. Locate junction boxes to allow ready access to junction box covers without removing any equipment.

H. All outdoor boxes shall be UL listed for wet location service.

I. Provide rigid support to structure for all junction boxes.

J. Provide rigid support to structure for all conduit within 3 feet of each junction box and a maximum spacing of 10 feet.

K. Install junction boxes above ceilings in readily accessible with no obstructions, locate within 18 inches of finished ceiling to facilitate easy access.

L. For all flexible whips to light fixtures provide wire support at mid-length of whip to structure above with UL listed conduit support clip.

M. Provide outlet boxes to meet depth requirement of Architectural walls. Refer to Architectural Spec Section 09250 and 10611 for wall partitions.

3.6 ADJUSTING

A. Install knockout closures in unused openings in boxes.

3.7 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

3.8 INSTALLATION - FLOOR BOXES

A. Use cast floor boxes for installation in slab on grade.

B. Set floor boxes level.

C. Install boxes and fittings to preserve fire resistant rating of slabs and other elements, using materials and methods specified in Section 26 05 29.

3.9 ADJUSTING

A. Adjust floor box flush with finish material.

3.10 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

3.11 ABOVE CEILING JUNCTION BOXES

A. Labeling: Provide label on all above ceiling junction boxes.
   1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Nameplates.
   2. Underground Warning Tape.
   3. Lockout Devices.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical identification, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and standards: Comply with the following:
   1. National Electrical Code, NFPA No. 70.
   2. NEMA standards applicable to the product provided.
   3. UL standards applicable to the product provided.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
   1. Panduit Corp.
   2. American Labelmark Co.
   3. Markal Corp.
   4. Calpico, Inc.
   5. Ideal Industries, Inc.

2.2 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

B. Emergency Power panels and Equipment: Laminated three-layer plastic with engraved white letters on **RED** background.

C. Letter Size:
   1. 1/4 inch high letters for identifying individual equipment and loads.

D. Minimum nameplate thickness: 1/8 inch.

2.3 UNDERGROUND WARNING TAPE

A. Description: four (4) inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
4. Secure nameplate to equipment front using screws, rivets, or adhesive.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
6. Install nameplates for the following:
    a. Switchboards
    b. Panelboards
    c. Transformers
    d. Service Disconnects
        1) Enclosed Switches
    e. Motor Control Centers
    f. Stand-alone Motor Controllers
    g. Generators
    h. Contactors

C. Underground Warning Tape Installation:
1. Install underground warning tape along length of each underground conduit, raceway, or cable six (6) to eight (8) inches below finished grade, directly above buried conduit, raceway, or cable. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
2. Install line marker for underground wiring, both direct buried and in raceway.

D. Printed Panelboard Directory:
1. Provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker for that panel, switchboard, or motor control center.
2. Panelboard directory shall include a legend indicating insulation color corresponding each phase and voltage in the building electrical system.
3. Copy in Owner’s Manual.

3.3 ABOVE CEILING JUNCTION BOXES

A. Labeling: Provide label on all above ceiling junction boxes.
   1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box.

3.4 ARC FLASH WARNING LABEL

A. Switchboards, panel boards and motor control centers requiring examination, adjustments, servicing or maintenance while energized shall be field marked to warn persons of arc flash hazards. Marking shall be located so as to be clearly visible to qualified persons before servicing or maintenance.

END OF SECTION 26 05 53

SECTION 26 09 14 - ELECTRICAL CONTROLS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract and the requirements of Section 26 05 00 apply to Work specified in this Section.

1.2 SUMMARY

A. Provide complete and operational electrical control systems as outlined within this Section.

B. Refrigerant detection and alarm system is provided by Division 23 Mechanical.

C. Elevator Shutdown System(s): All heat detectors, supervisory addressable modules, and supervised fire alarm wiring shall be furnished and installed as part of building fire alarm system. Refer to section 28 31 00 for additional requirements of fire alarm system.

1.3 SUBMITTALS

A. Provide submittals according to Section 26 05 00. Coordinate with section 28 31 00 Fire Alarm System Submittal for Items to be furnished and installed as part of the Fire Alarm System.

B. Product Data:
   1. Component manufacturer's literature explaining all components of each system.

C. Shop Drawings:
   1. Complete point to point interface and control wiring schematics.
   2. Show size and location of all fused elevator shutdown switches and panels. Identify all fuse types, quantity and ampacity.

D. Closeout Submittal: Provide manuals as described in Section 26 05 00.

1.4 OWNER'S INSTRUCTION

A. Provide a one hour period of instruction for each system to the Owner's designated personnel upon completion of system installation. Instruction shall include a functional training session on operation and system test procedures.

B. Elevator Power Shutdown System: Schedule instruction after building fire alarm system becomes operational. Demonstrate that heat detector(s) is connected to the building fire alarm system and that fire alarm system output connects into shunt trip circuit of the elevator power shutdown switch(s).

1.5 EXTRA MATERIALS

A. General: Provide extra material's for Owner's use. All parts shall be identical to installed components.

B. Fuses:
   1. Full Set: A full set is (three phase) of each different ampacity fuse in an elevator shutdown panel and in each elevator shutdown switch.
   2. Provide two full sets of spare fuses for each elevator shutdown panel and switch. Fuses blown and replaced during construction and commissioning do not count as spares.
   3. Provide a metal cabinet in each elevator machine room for the spare fuses. Cabinet shall be furnished by the fuse manufacturer or approved equal.

PART 2 - PRODUCTS

2.1 ELEVATOR POWER SUPPLY AUTOMATIC DISCONNECT SYSTEM:

A. General: Provide an elevator power automatic disconnect system in each elevator equipment room as required by ASME A17.1 Elevator Safety Code Rule 102.2 (c). Heat detectors and other parts of automatic disconnect means shall be separate from, and independent of, the building fire alarm system. Disconnecting means shall not be self-resetting.

B. State Regulation: Make arrangements for all inspections required by State of Texas. Correct any deficiencies in elevator electrical power supply automatic disconnect system that may be noted by State elevator inspector. Repeat until successful completion of all State of Texas Inspection Reports and Certificates of Compliance as required for ELEVATORS, ESCALATORS AND RELATED EQUIPMENT by the Texas Department of Licensing and Regulation.

C. NFPA: Comply with National Fire Protection Association Standard 72-1999, National Fire Alarm Code, Sect. 3-9.4 (1996 NFPA 72 section 3-8.15).

D. Disconnecting Means:
   1. Single-Car Machine Room: Provide Bussmann Power Module Switch Cat. No. PS in NEMA 3R enclosure. Switch rating amps shall be next size larger than fuses. All fuses shall be Class J current-limiting fuses. Provide shunt trip, 120 Volt control power transformer, Bussmann Option R2 fire alarm interface relay and key test switch for elevator feeder. Entire assembly shall be UL-listed and have 200,000 RMS symmetrical ampere interrupting rating.
   2. Class J Fuse Sizing: 175% Full Load Amps per elevator motor.
   3. Enclosure: NEMA 3R.
   4. Label: Label shunt-trip fused switch "Elevator Automatic Disconnect".
   5. Install wiring to remote heat detectors. Bussmann Option A: Comply with NEC 620-91 (c). For each hydraulic elevator that has automatic recall, provide one Bussmann Option A with fused switch for that elevator shutdown. Option A is a normally-closed mechanical interlock. It prevents inadvertent recall of hydraulic elevator. Automatic recall for hydraulic elevator is typically a Division 14 item for battery pack and electric solenoid on the hydraulic valve at the elevator controller. Automatic recall is typically provided when the hydraulic elevator is not on standby generator power.

E. Heat Detector:
   1. Install an approved heat detector with replaceable heat element within two feet of each sprinkler head in each elevator equipment room, each elevator pit, and in each elevator hoistway. Connect all heat detectors to contactor shunt trip(s) described above. Heat detector shall cause shunt trip to open the contactor associated with each elevator fused switch.

2. Heat detector shall have a lower temperature rating than the sprinkler head. Ex. 135°F-fixed temperature detector versus 165°F sprinkler.
3. Heat detector shall also have higher sensitivity than sprinkler. Detector higher sensitivity is often characterized by lower response time index (RTI). Listed spacing of heat detector shall be 40 feet or greater (NFPA 72, sect. Appendix 3-8.15.1).
4. Heat detector shall be combination rate-of-rise and fixed-temperature design as recommended in ASME Handbook to ANSI/ASME A17.1 Safety Code for Elevators and Escalators, explanation for Rule 102.2 (c)(3).

5. Install a heat detector at each sprinkler head in all following locations that have sprinklers:
   a. Elevator machine rooms;
   b. Elevator hoistway;
   c. Elevator pit.

6. Heat detector shall be Notifier Model No. HD-621 or approved equal. Detector shall have Normally Open, dual output contacts. Both contacts shall be rated at least 3A @ 6-125 Vac and 1A @ 6-28 Vdc.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. All components shall be properly mounted and wired.

3.2 INTERFACE WITH INVOLVED EQUIPMENT:

A. Each system shall have all necessary control circuitry, relays, and contacts to provide functions as specified, and shall be capable, if necessary of interfacing to voltages 12-120 AC/DC, N/O or N/C contacts, wet or dry contacts, and momentary or maintained signal required. Verify type of interface control required with manufacturer of associated equipment. Provide necessary control power system for any wet contacts that are required, including control transformers, rectifiers, wiring, circuit breakers, etc.

3.3 CONTROL POWER SUPPLY:

A. Elevators: Provide 120 volt control power as required from the same 208/120 volt circuit breaker panelboard serving the various 120V branch circuits in the elevator machine room.

3.4 ELEVATOR DISCONNECT:

A. National Electrical Code:

NEC 620-51 (b): Provide a disconnecting means for main power supply conductors to each elevator car. The elevator disconnecting means shall be part of the automatic shutdown system to open the power supply prior to application of sprinkler water.

NEC 620-51: The disconnecting means for the main power supply conductors to each elevator car shall not disconnect the branch circuits required by NEC 620-22, 620-23 and 620-24.

3.5 TESTING:

A. Test each system in the presence of the Owner, Architect, and Engineer to verify proper operation of elevator power supply automatic disconnect systems.

B. State Elevator Inspector: Include State Elevator Inspector in test witnessing. At the sole option of the State Elevator Inspector, provide separate testing as that person may require. Provide all testing of disconnect systems as required by State Elevator Inspector to allow all Inspection Reports and Certificates of Compliance to be completed.

END OF SECTION 26 09 14

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes enclosed contactors for lighting and general purposes. Provide complete systems using contactors, relays, photocells, time clocks, or digital time switches, where required, all properly mounted in enclosures.

1.3 SUBMITTALS

A. Product Data: Submit dimensions, size, voltage ratings and current ratings.

B. Short circuit current rating (SCCR) of equipment.

C. U.L. Label.

D. Electrical characteristics of equipment.

E. Enclosure metal gauge and finish.

1.4 CLOSEOUT SUBMITTALS

A. Provide manuals as described in Section 26 05 00.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS

A. General: Provide contactors and relays with ratings as indicated or as required to operate the installed load at the applied voltage using the applied contact voltage. Contactor shall be rated for making and breaking motor or other inductive loads.

B. Manufacturers:
   1. ASCO
   2. Square D
   3. GE

C. Enclosure: Provide a NEMA 1 enclosure for all contactors located indoors. Provide NEMA 4X for those located outdoors and in wet areas.

D. Lighting Contactors:
   1. Mechanically held, electrically operated.
   2. ASCO 918 or approved equal.

3. Provide ASCO Accessory 47 for two-wire control of contactor. Provide time switch and photocell to control contactor.
4. Some lighting contactors may be designated for control by Division 23 Building Automation System (BAS). Provide contactor and ASCO solid-state Accessory 47 for two-wire control of contactor. Division 23 shall provide all BAS control wiring. BAS provides all time-of-day ON/OFF scheduling.
5. Three-phase Contactors: When lighting contactors are indicated to control an entire panel or sub-panel, provide ASCO 920 or approved equal. Include two-wire control relay ASCO Accessory 47.
6. Parking Lot, Exterior Lighting and Sport Lighting Contactors: Provide 3-phase, 3-pole ASCO 920 contactors as indicated on Drawings. Include two-wire control relay ASCO Accessory 47. Also provide solid state control module and housing with Hand-off-Auto selector switch. All contactors that control any branch circuit that serves any lighting fixtures or entire panels that feed outdoor lighting shall be provided with the HOA control feature.

E. SCCR: Contactor shall have short circuit current rating established by actual testing with specific overcurrent protection device. SCCR shall be UL-listed.

2.2 PHOTO-ELECTRIC CONTROLS:

A. Description:
1. General: Photo-electric control shall switch load ON at dusk and OFF at dawn.
2. Housing: Photocell shall be enclosed in a weatherproof, corrosion resistant housing. The housing shall have a 1/2 inch I.P.S. nipple with a locking washer.
3. Element: Light sensing element shall be Cadmium-Sulfide cell hermetically sealed against moisture. Minimum time delay before change-of-state shall be 15 seconds. If the photo-electric control fails, the load shall switch ON (fail-safe ON).
4. Adjustment: The housing shall have an adjustable slide shield to vary the ambient light reaching the CdS cell. The slide shield shall not override the control; that is, the ON/OFF function shall occur even when the shield is at either extreme of the adjustment range. Adjustment shall be made by hand without tools.
5. Temperature: The photocell shall be suitable for operation in an ambient temperature range of -30 degrees Fahrenheit to + 140 degrees Fahrenheit.
6. Voltage: The photocell shall be suitable for use at voltage equal to the load voltage (120, 208, 277).
7. Capacity: Photocell shall be SPST rated for a minimum of 1800 Volt-Amps resistive or inductive load.
8. Leads: Photocell shall have minimum six (6) inch wire leads with wet location insulation. Leads shall be color coded Red/Load, Black/Line and White/Neutral.
9. Listing: Photocell shall be listed by Underwriters Laboratories.

B. Manufacturer: Intermatic, Paragon, Precision, Tork.

2.3 TIME CLOCKS:

A. Manufacturer:
1. Grasslin
2. Intermatic
3. Paragon
4. Precision
5. Tork

B. General: Provide time clocks similar to Intermatic Series T 1900 or Tork B8000 Series. Provide wiring to photocells, contactors, relays or other control points as required.

C. Contacts: Rated for 20 amps minimum at 277 volts. Provide 1, 2, 3 or 4 pole, single or double throw, maintained or momentary contact, as required based on the time clock function and the number of branch circuits controlled. Contacts shall be horse power rated when motors are switched.

D. Dial: Provide 24-hour dial with 15 minute intervals minimum. Dial shall permit at least 48 ON/OFF cycles per day via 96 adjustable tabs. Dial shall include a skip-a-day wheel and two day-omitting pins. Provide extra trippers and day-omitting pins if required.

E. Special Dials: Provide special dial where indicated on drawings or in these specifications. Provide astronomic dial for time clock controlling outdoor lighting.

F. Timing Motor: Provide heavy duty synchronous timing motor, self-starting and permanently lubricated. Motor shall be permanent magnet type for high torque and operate through and ambient temperature range of - 30 degrees Fahrenheit to + 130 degrees Fahrenheit. Motor cover shall have a viewing window to check for rotation of gears. Motor voltage shall be 120, 208, 240 or 277 volts as required.

G. Reserve Power: Provide a spring driven reserve power drive to operate time clock for at least ten (10) hours after a power failure.

H. Manual Bypass:
1. Time clock shall include a manual ON/OFF bypass switch capable of overriding time schedule without disturbing trippers or timing sequence.
2. Time clock shall be installed with a pilot-light SPST toggle switch mounted in a separate, adjacent single-gang box. Switch shall be labelled "Bypass" and shall function to turn ON circuit(s) controlled by the time clock. Switch shall be flush or surface mounted to match time clock housing.

I. Terminals: Time clock shall have a terminal block with screws for line, load, and grounding connections with up to AWG #8 wire. Provide a removable dead-front terminal cover within the time clock case. Timing motor shall have separate, unswitched terminals.

J. Enclosure: Provide a NEMA 1 enclosure with hasp suitable for padlock and side-hinge door for all clocks located indoors. Enclosure shall have 1/2 inch and 3/4 inch knockouts in bottom and sides. Provide NEMA 4X for those located outdoors and in wet areas.

K. Nametag: Provide a nametag for each time clock stating load controlled; see Section 26 05 53, Electrical Identification.

L. Listing: All time clocks shall be listed by Underwriters Laboratories and C.S.A.

M. Manuals: Provide three sets, each consisting of operating instructions and one-line diagrams.

2.4 DIGITAL TIME SWITCHES:

A. Recessed in wall: Wattstopper TS-400 or approved equal.

1. The digital time switch shall be programmable to turn lights off after a preset time.

2. Time switch shall be a completely self-contained control system that replaces the standard toggle switch. It shall have a ground wire and ground strap for safety. Switching mechanism shall be a latching air gap relay.

3. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the switch's longevity.
4. Time switch shall be compatible with all electronic ballasts, motor loads, compact fluorescent and inductive loads. Triac and other harmonic generating devices shall not be allowed.
5. Time switch shall operate at universal voltages of 100-300 VAC; 50/60 Hz.
6. Time switch shall have no minimum load requirement and shall be capable of controlling 0 to 800 watt incandescent, fluorescent @ 100/120 VAC, 50/60 Hz; 0 to 1200 watts fluorescent @ 230/277 VAC, 50/60 Hz; 1/6 hp @ 125 VAC.
7. Time scroll feature shall allow manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
8. Time switch shall have the option for a one second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
9. Time switch shall have the option for a beep warning that shall sound every five seconds once the time switch countdown reaches one minute.
10. Time switch shall have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
11. Time switch shall have an electroluminescent backlit Liquid Crystal Display that shows the timer's countdown.
12. Time switch shall fit behind a decorator style faceplate. The calibration switch for setting time-out, time scroll, one second light flash, and beep warning shall be concealed to prevent tampering of adjustments and hardware.
13. Time-out period shall be adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
14. Time switch shall be capable of operating as an ON/OFF switch.
15. For ease of installation and cleaner wiring, the switch shall utilize terminal style wiring.
16. The time switch shall not protrude more than 1/8" from the wall and should blend in aesthetically.
17. For safety, the time switch shall have a 100% OFF override switch with no leakage current to the load.
18. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the time switch shall automatically switch to OFF mode.
19. To ensure quality and reliability, time switch shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
20. Time switch shall have 5 year warranty and shall be UL and CUL listed.

2.5 OCCUPANCY SENSORS:

A. Ceiling Sensors: Require power packs
   1. W-2000- Low voltage ultrasonic ceiling mounted with 2000 square foot coverage. Typical for large restroom.
      DT-300- Low Voltage dual technology ceiling mounted with isolated contact. Typical for classrooms.
   2. WT-2250/2255- Typical corridor sensor- Low voltage ultrasonic ceiling mounted with 10' by 90' coverage pattern

B. Wall Switch Sensors:
   1. PW-100 Line voltage PIR wall switch sensor for 1 circuit- Typical for small office or single person restroom.
      PW-100-24 Low Voltage PIR wall switch sensor. Requires power pack
      PW-200- Line voltage PIR wall switch sensor for 2 circuits,
      UW-100- Line Voltage ultrasonic wall switch sensor for 1 circuit.
      DW-100- Line voltage dual technology wall switch sensor for 1 circuit. Typical for large office or conference room.
      DW-100-24- Low voltage dual technology wall switch sensor. Requires Power Pack
      DW-200- Line voltage dual technology wall switch sensor for 2 circuits
   2. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
   3. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180˚ coverage capability.
   4. Wall switch products shall utilize Zero Crossing Circuitry which increases relay lifeprotects from the effects of inrush current, and increases sensor's longevity.
   5. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
   6. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.
   7. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.

C. Power and Auxiliary Packs:
   1. BZ-50- Standard power pack for use with low voltage sensors. 225ma
   2. BZ-150- Power pack for use with low voltage sensors when using a manual on function. 225ma
   3. S120/277- Slave relay pack. For controlling more than 1 circuit from a low voltage sensor. Standard BZ-50 can also be used.

D. High Ceiling Applications
   1. HB-350B*LENS Low Voltage PIR sensor
   2. L1 Lens- 20' x 60' coverage pattern when mounted at 40'
   3. L3 Lens- 40' diameter coverage pattern when mounted at 40'
   4. L4 Lens- 60' diameter coverage pattern when mounted at 60'

E. Passive infrared sensors:
   1. Passive infrared sensors shall utilize Pulse Count Processing and Detection Signature Processing to respond only to those signals caused by human motion.
   2. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
   3. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
   4. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

F. Dual technology sensors:
   1. Dual technology sensors shall be wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
   2. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

G. Ultrasonic sensors:
   1. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
   2. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002% tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

H. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.

I. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

J. When specified, sensors shall utilize SmartSet™ technology for automatically adjustable time delay and sensitivity settings.

K. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

L. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

M. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

N. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

O. All sensors shall have UL rated, 94V-0 plastic enclosures.

P. All occupancy sensors shall be set to maximum 30 minute time delay.

Q. Provide minimum 5% spare sensors for owner stock of each type of occupancy sensor.

2.6 DAYLIGHT HARVESTING – Wattstopper LightSaver® LS-102 Daylighting Controller

A. The light level controller shall be capable of detecting changes in lighting levels.

B. The light level controller shall utilize an internal photocell that measures light in a 100 degree angle cutting the unwanted light from bright sources outside of this cone.

C. The light level controller shall be capable of controlling any type of lighting through use of power packs. Light level controller shall operate from a 24 volts DC power supply; current draw is 22 milliamps.

D. The LS-102 light level controller shall be capable of turning lighting on and off for a single zone and has a light sensors over 1 to 1400fc.

E. The light level controller shall have an adjustable deadband feature with 25%, 50%, 75% or 100% in relation to the setpoints. This prevents lighting from cycling when lighting goes on and off and from minor changes due to cloud cover.

F. The light level controller shall have an adjustable time delay range of 3, 10, 15 or 30 minutes. This will prevent cycling on partly cloudy days and is necessary with HID lighting.

G. The LS-102 shall provide a connection for an optional low voltage, normally open momentary contact watt switch override.

H. The LS-102 provides a “hold on while occupied” feature that prohibits high levels from turning OFF the controlled lights as long as the space remains occupied.

J. The LS-101 has an ON Setpoint range from 1-850fc and when the daylight drops below that setpoint for 20 seconds the electric lights will be turned ON.

K. The LS-102 has a microprocessor that allows the photosensor to respond with precision to deliver the desired intensity of electric lighting for the space.

L. The light level controller has a LED status indicator making it easy to identify if the device has been forced on or off by an override switch or if the device is in test mode.

M. The LS-102 has a threaded nipple that mounts on a ceiling tile and for more challenging applications such as a side wall or hard rock ceiling the nipple pops off and the LS-101 can be screwed down.

N. Light level controller shall have standard 5 year warranty.

PART 3 - EXECUTION

3.1 PHOTO-ELECTRIC CONTROL MOUNTING:

A. Provide photo-electric control on roof of building. When more than one building is constructed on site, install photo control on each roof. Aim true North and locate in places where ambient night lighting will not cause interference. Wire down to respective contactors in each building.

3.2 TIME CLOCK PROGRAMMING:

A. Install time clock and photocell for ON by photocell at dusk, OFF by time clock at midnight, then ON by time clock at 5:00 a.m. and OFF by photocell at dawn. Program time clock ON/OFF times to other time(s) when indicated on Drawings.

3.3 INSTALLATION

A. Install enclosed contactors (as indicated on Drawings), in accordance with NECA "Standard of Installation".

B. Install engraved nameplates. Refer to Section 26 05 53 for requirements.

C. Install contactor and relays in Electrical / Mechanical Rooms unless otherwise noted.

END OF SECTION 26 09 23

SECTION 26 20 00 - ELECTRICAL DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Conditions of the Contract Documents and Division 1 - General Requirements as applicable, apply to this Section.

1.2 SUMMARY

A. Provide all electrical distribution and motor control equipment and accessories required to distribute electrical power to all motors, outlets and systems requiring power.

1.3 QUALITY ASSURANCE

A. New: Provide all new equipment.

B. Single Manufacturer: All equipment of each type shall be the product of one manufacturer.

C. UL: Equipment shall be UL listed. Service entrance equipment shall bear UL Service Entrance label.

D. NEC: Equipment and installation shall comply with the National Electrical Code.

E. Wet Locations: Equipment and enclosures installed outdoors and in wet locations shall be approved for the purpose.

F. IEEE: Institute of Electrical and Electronics Engineers Standard 1015-1997 (Blue Book) Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.4 LABELING

A. Nameplates and labeling shall be provided in accordance with Section 26 05 53. All feeders shall be labeled at the feeder device.

1.5 FINISHES

A. All equipment shall have a factory applied gray finish applied over a rust inhibiting treatment. Any items which have the finish marred shall be touched up or refinished to a new condition before final acceptance. This shall include, but shall not be limited to, sanding and properly removing rust or other contaminants and completely repainting equipment if damage is extensive. Overall acceptance is subject to approval of the Engineer.

1.6 SUBMITTALS

A. Provide complete product data for each equipment type. Provide electric service studies when required.

B. Submittal shall include written recommendation from manufacturer of settings for all electronic trip adjustment setting on all equipment furnished with adjustable trip settings. Contractor is responsible for adjusting all electronic trip settings per manufacturer recommendations.

C. Electrical connections to all equipment furnished by any other division shall be coordinated with final approved equipment submittals from other divisions including but not limited to circuit breaker sizes, conduit sizes, wire sizes, fuse sizes, disconnect switch sizes and starter sizes that differ from those shown on the drawings prior to submitting Electrical Distribution Equipment submittal.

1.7 SHORT CIRCUIT CURRENT RATINGS

A. General: All switchboards and panelboards shall be fully rated and marked with a maximum short circuit current rating. The equipment manufacturer shall have verified this rating with high-amperage testing. All short circuit current ratings are expressed as amperes RMS symmetrical at the applied voltage unless otherwise noted. All equipment shall withstand the specified level of fault current. All overcurrent devices shall interrupt the specified level of fault current.

1.8 ELECTRIC SERVICE STUDIES

A. Standard: Submit studies in accordance with ANSI/IEEE Standard 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

B. Submit one-line diagram for each electrical service. Key all equipment and components on diagram to items in the studies.

C. Provide a short-circuit current analysis for each main switchboard. Short-circuit analysis shall calculate short-circuit levels at service transformer secondary, switchboard main breaker, each feeder breaker and all levels of downstream distribution equipment. Assume infinite source bus.

D. Provide a time-current coordination study for each main switchboard. Coordination study shall compare the operating levels and times of the protective devices to the withstand levels and times that the equipment can sustain without damage or failure. Determine electronic trip unit settings necessary to achieve optimal selective coordination between 480 volt main service circuit breaker and first level of feeder distribution devices. Determine setting for all adjustments of trip units of all electronic circuit breakers that are linked by zone-selective-interlocking. Furnish time-current curves for the two (or more) levels of distribution protected with electronic trips, plus the first additional distribution level served from the switchboard feeder. Show a separate composite plot for each feeder breaker trip rating with the main breaker. Plot composite time-current curves on log-log background. Add a typical frame size of downstream molded-case circuit breaker to each switchboard feeder composite plot.

E. Contractor shall make all adjustments to circuit breakers per electric service study and provide written documentation that all adjustments have been made.

1.9 OWNER'S INSTRUCTION

A. Provide a four hour period of instruction to the Owner's designated personnel upon completion of the main switchboards installation. Instruction shall include a functional training session on digital metering system operation and system test procedures. Review manufacturer’s recommended switchboard maintenance. The Operations and Maintenance Manual shall be complete and on-site at the time of Owner instruction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Unless indicated otherwise, all equipment in this section shall be provided from a single manufacturer. The product designations listed are to establish a level of quality. Acceptable manufacturers are,
   1. Square D
   2. Siemens
   3. G.E.
   4. Cutler-Hammer

2.2 ENCLOSED SWITCHES

A. General: Provide heavy duty enclosed switches similar to Square D Class 3100 Type HD.

B. Switch Interior:
   1. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
   2. Lugs shall be front removable and UL Listed for 75 degrees Celsius conductors.
   3. All current carrying parts shall be plated to resist corrosion.
   4. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
   5. Switches shall have provisions for a field installable electrical interlock.

C. Switch Mechanism:
   1. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
   2. The operating handle shall be an integral part of the box, not the cover.
   3. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
   4. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.
   5. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

D. Switch Enclosures:
   1. Switch covers shall be attached with welded pin-type hinges.
   2. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel.
   3. The enclosure shall have ON and OFF markings stamped into the cover.
   4. The operating handle shall be provided with a dual colored, red/black position indication,
   5. All switches shall have provisions to accept up to three (3) 3/8 inch hasp padlocks to lock the operating handle in the OFF position.
   6. Tangential knockouts shall be provided to facilitate ease of conduit entry.

E. Switch Ratings:
   1. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.
   2. The UL Listed short circuit current rating of the switches shall be 200,000 rms symmetrical amperes when used with or protected by Class J fuses.
   3. Non-Fusible: 10,000 rms symmetrical amps.

F. Fuse Clips: NEMA FU 1, Class J fuses.

2.3 SINGLE CIRCUIT BREAKERS WITH ENCLOSURES

A. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.

B. Circuit Breakers: Molded case, quick make, quick break, trip free, common thermal magnetic trip.

C. Ratings: Continuous current, poles as required, 480 volt system breaker shall interrupt short circuits up to 14,000 rms amps symmetrical; on 120/208 - 240 volt system, 10,000 amp rms symmetrical.

D. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R.

E. Nameplate: Provide a nameplate showing load served.

2.4 FRACTIONAL HORSEPOWER MANUAL MOTOR CONTROLLER

A. Square D - Class 2510 Type F.
   1. Description: NEMA ICS 2, ac general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.
   2. Enclosures: ANSI / NEMA ICS 6, Type as indicated.

2.5 MAGNETIC MOTOR CONTROLLERS

A. Square D - Class 8536 Type S.
   1. Description: NEMA ICS 2, ac general-purpose Class A magnetic controller for induction motors rated in horsepower.
   2. Coil Operating Voltage: Provide as required to interface with controls system, including control power transformer.
   3. Coil: Be of encapsulated type.
   4. Poles: as indicated.
   5. Size: as indicated.
   6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
   7. Wiring: Straight-through wiring with all terminals clearly marked.
   8. Overload Relay: NEMA ICS.
      a. Solid State: Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
      b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
      c. Reset: Unit shall include both manual reset and remote reset using an external module.

d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.

9. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
10. Control Power Transformers: 120 volt secondary. VA minimum, in each motor starter. Provide fused primary and secondary.
11. Provide red LED running pilot light and H-O-A switch.

2.6 MAGNETIC MOTOR CONTROLLERS - TWO - SPEED

A. Square D - Class 8810 Type S.

1. Description: Include integral time delay transition between FAST and SLOW speeds. Starters shall be electrically and mechanically interlocked to prohibit both starters being energized simultaneously.
2. Coil operating voltage: Provide as required to interface with controls system, including control power transformer.
3. Coil: Be of encapsulated type.
4. Poles: as indicated.
5. Size: as indicated.
6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts.
7. Contact inspection and replacement shall be possible without disturbing line or load wiring.
8. Wiring: Straight-through wiring with all terminals clearly marked.
9. Overload Relay: NEMA ICS.
   a. Solid State; Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
   b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
   c. Reset: Unit shall include both manual reset and remote reset using an external module.
   d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
10. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
11. Two speed motor controllers shall be designed for type of motor winding specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.
12. Provide red-high, amber-low running pilot lights and H-O-L-A switch.
13. Provide two speed motor controllers for all two speed motors specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.

2.7 COMBINATION DISCONNECT / MOTOR STARTERS

A. Square D - Class 8538 Type S (Fusible or no fuse, as shown on plans).

1. Description: Combine magnetic motor controllers with fusible switch disconnect in common enclosure. Switch shall have a color coded externally operated handle. Operating handle shall give positive visual indication of ON/OFF with red and black color-coding.
2. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class J fuses and visible

blades. Operating handle shall give positive visual indication of ON/OFF with color-coded operating handle.

3. Magnetic Motor Controllers: Refer to paragraph(s) specifying magnetic motor controllers for requirements.

2.8 FUSES (600 VOLTS AND BELOW)

A. Manufacturers:
   1. Bussmann.
   2. Little Fuse
   3. Ferraz Shawmut

B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.

C. Voltage: Rating suitable for circuit phase-to-phase voltage.

D. Class J (Time Delay) Fuses
   1. Dimensions and Performance: NEMA FU 1.
   2. Voltage: Rating suitable for circuit phase-to-phase voltage.
   3. Dual-element, time delay ten (10) seconds (minimum) at 500 percent rated current.

E. Spares: Spare fuses shall be provided in the amount of ten (10) percent of each type and size installed. Replacement for fuses and limiters blown during construction shall not count as spares.

2.9 TWO-WINDING TRANSFORMERS

A. Product Description: Provide transformers in accordance with the following standards, where applicable:
   1. Underwriter's Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
   2. Underwriter's Laboratory 506, Standard for Safety for Specialty Transformers
   3. NEMA ST 20, Dry Type Transformers for General Applications
   4. NEMA 250, Enclosures for Electrical Equipment (1000 V Max)
   5. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
   6. U.S. Department of Energy 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, dated April 18, 2013. These efficiency standards shall take effect January 1, 2016. All transformers covered in the scope of this document and this specification, manufactured after December 31, 2015, shall be compliant with the new standard.

B. Ratings as indicated on Drawing.

C. Primary Voltage: 480 volts, 3 phase or as indicated on plans.

D. Secondary Voltage: 208Y/120 volts, 3 phase or as indicated on plans.

E. Insulation system and average winding temperature rise 150 degrees Celsius over 40 degrees Celsius ambient.

F. Winding Taps:
   1. 2 at 2.5 percent above rated voltage.
   2. 4 at 2.5 percent below rated voltage.

G. Sound Levels: NEMA ST 20. Noise levels shall not exceed NEMA and ANSI Standards.

H. Basic Impulse Level: 10 kV for transformers less than 300 kVA.

I. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.

J. Mounting:
1. 1-15 kVA: Suitable for wall mounting.
2. 16-75 kVA: Suitable for floor mounting.
3. Larger than 75 kVA: Suitable for floor mounting.

K. Coil Conductors: Continuous copper windings with terminations brazed or welded.

L. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.

M. Isolate core and coil from enclosure using vibration-absorbing mounts.

N. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.10 TRANSFORMERS FOR NONLINEAR LOADS

A. Nonlinear load transformer shall be as specified for two winding transformers except as modified by this Section.

B. Product Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, designed to supply nonlinear load, UL K-9 rated.

C. Primary Voltage: 480 volts, 3 phase.

D. Secondary Voltage: 208Y/120 volts, 3 phase.

E. Insulation and temperature rise: Class 220 insulation system with 115 degrees Celsius average winding temperature rise over 40 degrees Celsius ambient.

F. Coil Conductors: Continuous copper windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at 1.73 times the phase conductor ampacity.

G. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.

H. Isolate core and coil from enclosure using vibration-absorbing mounts.

I. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.11 DISTRIBUTION PANELBOARDS

A. Manufacturers: Square D I- Line, Class 2110.

B. Product Description: NEMA PB 1, circuit breaker type panelboard.

C. Panelboard Bus: copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.

D. Continuous current rating shall be sufficient to protect wiring and equipment served.
1. Panels 400A and smaller, 35,000 amperes rms symmetrical.
2. Panels greater than 400A: 65,000 amperes rms symmetrical.

E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

F. Main Circuit Breaker:
1. When distribution panel has main circuit breaker, provide molded case circuit breaker with electronic trip unit. Current sensing to be true-rms.
2. Main breaker shall have minimum interrupting rating of 65,000 amperes rms symmetrical at applied voltage.
3. Electronic trip shall be Square D micrologic with adjustable long-time, short-time and instantaneous pick-up set points.

G. Cabinet Front: Safety dead front type. Conform to NEMA 1; NEMA 3R if located outdoors. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

2.12 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers: Square D Type NQ for 208/120V, type NF for 480/277V.

B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard;

D. For non-linear load applications subject to harmonics furnish 173 percent rated, plated copper, solid neutral.

E. Minimum Integrated Short Circuit Rating: 14,000 amperes rms symmetrical for 208-240/120 volt panelboards; 22,000 amperes rms symmetrical for 480 volt panelboards.

F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.

G. Enclosure: NEMA PB 1, Type 1 or Type 3R. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

H. Cabinet Front: Safety dead front type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

I. Provide ground-fault circuit breaker for each heat trace branch circuit.

J. Panelboards indicated to have thru-feed lugs shall be furnished with thru-feed lugs in all sections of panelboard.

2.13 MOTOR CONTROL CENTERS

A. General:
1. Provide totally enclosed, freestanding, motor control center with sections joined together to form one rigid unit. Motor control centers shall be similar to Square D Model 6 Class 8998.
2. NEMA Class: I.
3. NEMA Wiring Class: Type B.
4. Standard: NEMA Standard ICS 2 Industrial Control and Systems.
5. Underwriters Laboratories: UL 845 "Electric Motor Control Centers". Each vertical section shall be UL listed. Each motor control unit shall be UL listed.

B. Installation: Freestanding on a four (4) inch concrete pad. Both the entire enclosure to the pad.

C. Structure:
1. Fabricated of code gage steel with steel doors formed into standardized units. Each vertical section shall have an independent isolated vertical wiring trough with full height hinged door. Back to back mounted devices in the same vertical bus module are unacceptable.
2. Structures shall be totally enclosed, dead front, freestanding assemblies.
3. Structure shall be NEMA type 1 gasketed general purpose.
4. Motor control center structures shall have continuous removable base channels. The top plate(s) shall be removable to facilitate cutting of conduit entry openings.
5. All steel parts shall be provided with a UL listed acrylic baked enamel or powder coat paint finish, except plated parts used for ground connections. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
6. Structures shall contain a minimum 12 inch high horizontal wireway at the top of each section and a minimum six (6) inch high horizontal wireway at the bottom of each section. These wireways shall run the full length of the motor control center to allow room for power and control cable to connect between units in different sections.
7. A vertical wireway shall be provided in each motor control center section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireways. The vertical wireway shall be barriered from control units and have a separate hinged door.
8. Unused spaces and spares shall have hinged doors.

D. Bussing:
1. Provide complete horizontal and vertical bussing with wiring spaces at top, bottom, and vertically in each section. All bussing shall be silver plated 98 percent conductivity copper.
2. The main horizontal bus shall be fully rated and shall extend the full length of the motor control center. Include provisions for splicing additional sections onto either end of the motor control center.
3. Each section that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of the same material and plating as the main bus, and shall be rated no less than 125 percent of motor FLA in that section. Vertical bus shall extend full height of section, including all spare and space units. For purposes of calculating vertical bus ampacity, each space shall count no less than FLA of smallest motor served in that section.
4. A tin or silver plated copper ground bus shall be provided that runs the entire length of the motor control center. The ground bus shall be rated no less than 1/3 of horizontal main bus amps. Provide a vertical ground bus in each section used for

plug-in units. Plug-in units shall have a ground stab arranged for first-make, last-break relative to the power bus stabs.

5. Motor control centers shall be separated into shipping blocks of no more than three vertical sections each.
6. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be isolated from the horizontal wireways and starters. Barriers shall be removable to allow access to the bus and connections for maintenance.
7. The vertical bus shall be housed in modular glass filled polyester supports that provide bus insulation. These supports shall have openings every three (3) inches for unit stab-on connections. Each opening shall be provided with a closing plug to close off the stab opening.

E. Terminations:
1. Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.
2. All starter units shall be provided with unit control terminal blocks.
3. Terminal blocks shall be the pull-apart type rated at 20 amps. The stationary portion shall be used for field connections and will remain attached to the cubicle when the unit is removed. The removable portion of the terminal blocks shall be used for the unit wiring factory connections.

F. Protective Devices:
1. Class J Fusible Switch-Starter Units: Plug in type with silver plated pressure type line disconnecting stabs of high strength copper alloy. Each unit shall be totally enclosed and effectively barriered, and shall be so designed that it can be located anywhere within the structure using the same overload heaters for the same load. Fusible switches shall be manually operated quick make, quick break, horsepower rated. Coordinate fuses and overload heaters for proper acceleration time of motors provided. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by 1 to 3 padlocks. Provide Class J fuse clips. Provide magnetic starter components as specified in Article MOTOR CONTROLLERS. Provide fuses field-installed in accordance with Article FUSES.
2. Circuit Breakers (with no motor controller): Molded case, bolted type, quick make, quick break, trip free, common thermal magnetic trips. Operating handle shall clearly indicate ON or OFF. Means shall be provided for locking each breaker in OFF position by one to three padlocks. Automatic tripping indicated by handle at center position.
3. Fused Switch (with no motor controller): Quick make, quick break, horsepower rated. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by one to three padlocks. Provide Class J Type fuse clips. Provide fuses in accordance to Article FUSES located in this section.
4. Starters: all starters for motor control center to be size 1 minimum or larger.

G. Short Circuit Current Ratings:
1. Protective devices, together with the bussing and bracing, shall safely and without failure withstand and interrupt short circuits on a system capable of delivering up to 65,000 amps RMS symmetrical at nominal system voltage. Provide higher ratings when indicated on the Drawings.
2. Bus bracing shall be provided for the entire bus network to withstand the mechanical forces generated during the specified short circuit.
3. The main device serving the motor control center, every motor control unit and other overcurrent devices installed in the motor control center shall have an interrupt rating no less than the specified short circuit.

4. The entire motor control center shall be suitable for operation at the specified available fault current. The motor control center shall be labeled by the manufacturer to indicate the maximum available fault current rating, taking into account the structure, bussing, main feeder and all units and devices included in the motor control center. This fault current withstand rating shall be the basis for the UL Short-Circuit Current Rating.

H. Nameplate:
1. Identify each device with nameplate showing load served. Refer to "Labeling" in Section 16050.
2. Provide a master nameplate on face of units similar to following, with correct data shown:
Motor Control Center
480 Volts, 3 Phase, 3 Wire, 60 Hertz
Main Bus:____amps. braced for_____ amperes RMS Symmetrical
Date Installed:
3. Provide a nameplate for each vertical section marked with section characteristics and factory identification. This nameplate may be manufacturer's standard construction.
4. Provide UL listing marks on each section and unit in manufacturer's standard format.

I. Submittal: Include at least the following:
1. Manufacturer and Model Numbers
2. Dimensions
3. Cable Termination Provisions
4. Current Ratings
5. Voltage Ratings
6. Short Circuit Ratings including proof of any UL-listed series ratings (if series rating allowed by specification).
7. Motor Controller and Protective Device Ratings, including catalog pages for all current-limiting devices.
8. Identify NEMA Class of submitted mcc.
9. Identify NEMA Wiring Type of submitted mcc.
10. Single Phase Relay
11. Unit Elevation
12. Bussing Schematic, Sizes and statement of Conductor and Plating Material.
13. Original Manufacturer Brochure and Specifications

2.14 MAIN SWITCHBOARDS:

A. General: Provide universal building–type switchboards fabricated in accordance with NEMA Standard PB–2, UL Standard 891, and bearing a UL Service Entrance Label. Switchboard characteristics are 480/277 volts, 3 phase, 4 wire. Main connection and unit-mounted branch connections shall be from the rear. Group mounted branch connections shall be from the front or the rear. The entire switchboard assembly shall be similar to Square D Type QED-2.

B. Structure:

1. The switchboard shall be freestanding and have front and rear alignment. Provide rear access to main device(s) and all unit-mount branch devices (2000A and less can be front access only). Provide front or rear access to group-mounted devices. Formed up steel channels bolted together to form a rigid structure to which formed up fronts, side sheets, and rear covers are bolted. Galvanized 1–1/2" x 3" mounting channels on bottom, rear, left, and right sides to close all openings at the bottom. Arrange for easy addition of future cubicles at end. Provide pull box, fabricated with unit at factory, on top of switchboard if required for proper entrances and exits of feeders.
2. When “SPACE” is indicated on one-line diagram, provide full bussing extension to serve that space and all overcurrent device mounting hardware for the given frame size.

C. Installation: Freestanding, level and bolted to a four (4) inch concrete pad.

D. Instrumentation:
1. General: Monitor the incoming line with a Square D PM 5563 meter with BACnet IP communication port protocol.
Meter shall have digital display adjustable to select phase. Monitor with an ammeter any feeder devices indicated on the Drawings.
2. Wiring Lugs: Provide ring lugs for all wiring terminations of potential transformers (PTs), current transformers (CTs) and current sensors. Fork lugs are not acceptable. Ring lugs are intended to minimize the chance of leads pulling apart and creating an open circuit. (Zero current reading).

E. Phase, Neutral and Ground Bussing: Silver plated 98% conductivity copper sized to comply with NEMA Temperature Rise Standard. In addition, copper bus shall be sized on the basis of a maximum temperature rise of 65 degree C. The vertical bussing per cubicle shall be sized not less than the sum of all devices, including spare spaces, to be served from that cubicle. **The vertical bus shall be a minimum of 2000 amperes and shall be full height**. Bus supports, connections, and joints shall be bolted with SAE Grade 5 medium carbon steel bolts employing Belleville washers. Provide complete bussing, mounting provisions for circuit protective devices and space screw cover wherever the drawings indicate space only. Arrange and drill bussing for **future full capacity extension**. Provide a full length ground bus, with minimum ampacity of 1/3 phase bus ampacity. Provide full–size neutral rated at 100 percent of phase bus.

F. Terminations: Provide proper incoming line lugs to accommodate cable shown on plans.

G. Short Circuit Ratings:
1. Distribution board assembly of protective devices, together with the bussing and bracing, shall be fully-rated to withstand and interrupt short circuits on a system capable of delivering up to 65,000 amps RMS symmetrical at nominal system voltage.

H. Provisions for Auto Power Factor Controller (APFC):
1. Provide a circuit breaker with adjustable electronic tripping to protect and disconnect the automatic power factor controller.
2. Set amp trip at minimum 150 percent of ampacity for the actual KVAR installed.
3. Provide buss CTs on main incoming buss for use by the remote auto pf controller. These CTs shall be separate and in addition to all other CTs required for switchboard metering. Install a shorting terminal block on CT until the auto pf controller is installed at the job site.
4. Refer to Section 26 35 33 for additional requirements of auto pf controller.

I. Protective Devices:
   1. Distribution board Main Breaker:
      a. Stationary mounted, manually operated, 100 percent rated molded case circuit breakers with electronic tripping system and stored energy closing mechanisms. The electronic tripping system shall be similar to Square D Micrologic Full Function Trip unit. Main breakers shall be Square D.
      b. The breaker shall be UL Listed for continuous duty at 100% of the current rating.
      c. Minimum interrupting rating of 65,000 amperes rms symmetrical at 480/277 Volts.
      d. Local trip indicators: overload, short circuit and ground fault.
      e. Electronic sensing systems shall be true-RMS sensing and not susceptible to adverse harmonic current effects.
      f. Adjustments:
         1) The electronic trip unit shall have LSIG Trip functions.
   2. Feeder Devices:
      a. Breakers 700 Amps and Larger:
         1) Branch feeder breakers 700 amp and larger shall be molded case circuit breakers rated 100% with electronic trip units.
         2) Interrupting rating shall be at least 65,000 amperes rms symmetrical at 480/277 Volts.
         3) The electronic trip unit shall have LSI trip functions.
         4) The breaker shall be UL Listed for continuous duty at 100% of the current rating.

      b. Breakers 600 amps and smaller shall be type L (600A and 400A frame), J (250A frame), and H (150A frame) molded circuit breakers, AIC rating to match main breaker.
      c. The breaker shall be UL Listed for continuous duty at 100% of the current rating

J. Transient Voltage Surge Suppressor (TVSS):
   1. General: Provide a Square D Class 1310 240kA surge current rated mounted in the switchboard mounted above the main circuit breaker compartment.

K. Lightning and Overvoltage Surge Arrester:
   1. General: Provide a Square D SDSA3650 lightning and overvoltage surge arrester inside the switchboard housing, connected between the service entrance bussing and the ground bus.
   2. Description: Device shall be a heavy duty, three–phase, zinc metal oxide varistor (MOV), secondary class arrester rated for 650 volts and U.L. listed in Category (OWHX) of the Electrical Construction Materials Directory (Green Book). Device shall comply with ANSI/IEEE C62.11-1987 Standard for Metal Oxide Surge Arresters for AC Power Circuits.
   3. Installation shall comply with NEC Article 280. Provide fusing if required by installation instructions from arrester manufacturer.

L. Identification:
   1. General: Identify each device and meter with a nameplate showing load served. Refer to Article on LABELING in Section 26 05 00.
   2. Master Nameplate: Provide a master nameplate on face of boards similar to following, with correct data shown:

Main Switchboard_____
480/277 Volts, 3 Phase, 4 Wire, 60 Hertz
Main Bus:___amps. braced for___ RMS sym. amps.
Date Installed:

M. Submittal: Include at least the following:
1. Manufacturer and Model Numbers
2. Dimensions
3. Cable Termination Provisions
4. Current Ratings
5. Voltage Ratings
6. Short Circuit Ratings
7. Protective Device Ratings
8. Electronic metering system
9. Surge Arrester
10. Unit Elevation
11. Bussing Schematic, Sizes and Statement of Conductor and Plating Materials
12. Original Manufacturer Brochure and Specifications
13. Coordination drawing using dimensions of actual switchboard submitted. Show board footprint, proper clearances, and other equipment in same room.

N. Testing: Test all devices and systems to assure proper operation.

2.15 SERVICE ENTRANCE CABLE TAP BOX (CTB):

A. Cable Tap Box:
1. General: Provide weatherproof, freestanding phase collection and cable tap box. Fabricate in strict accordance with Electric Utility requirements. Line side connection from building pad-mounted transformer shall be through underground conduit and wire, load side connections to the building main switchboard(s) shall be weatherproof outdoor busway.
2. Structure: Formed up steel channels bolted together to form a rigid structure to which formed-up fronts, side sheets, and rear covers are bolted. Front and rear doors shall be hinged. Galvanized 1-1/2 inch x 4inches mounting channels on bottom, rear left, and right sides to close all side openings at the bottom. Interior framing shall be galvanized steel 1-5/8" rigid channel or approved equal system. Enclosure shall be tamper proof and outdoor weatherproof.
3. Installation: Freestanding and level on an outdoor concrete pad. Provide anchor bolts. Pad shall be outside all Electric Utility easements. Stub up conduits for Electric Utility service lateral and customer-side service entrance conduits. All underground conduit to/from CTB shall be concrete-encased.
4. Bussing: Insulated bussing, silver plated 98 percent conductivity copper. Bussing shall be sized in accordance with UL and NEMA Standards. In addition, size copper bus for not more than 1000 Amperes per cubic inch current density. Provide 3 phase, 4 wire, (100 percent neutral) bussing. Install with rigid supports to meet fault current rating.
5. Fault Current Rating: Bussing and bracing shall safely and without failure withstand short circuits on a system capable of delivering up to 100,000 amperes rms symmetrical at nominal system voltage. Install rope tie as required after cable installation to maintain bracing for short circuit current rating.

B. Electric Utility Requirements:
1. Prior to fabrication, submit three (3) prints of proposed cable tap box (CTB) to the representative designated by the Electric Utility. Submit prints only after shop drawings have been submitted and review cycle is complete with the Architect.

Allow at least eight weeks time for review by Electric Utility prior to desired date of new service cut-in. Allow additional time for Architect/Engineer review prior to submittal to Electric Utility.

2. Cable tap box enclosure shall be tamper proof and weatherproof. Entire cabinet shall be tamper-resistant.
3. Form roof with cross-kink to force water to run off the cabinet.
4. Paint Finish Color: Match color of Electric Utility padmount transformer. Minimum finish shall be prime coat plus at least 6 mils of finish coat paint in two (2) applications.
5. Provide full-height doors on both utility side and customer side. Each door shall be hinged and have a vault-style handle with padlocking provisions. Electric Utility will install its padlock. Provide weatherproof padlock on customer door and give Owner ten (10) copies of key.
6. Fabricate CTB with two separate compartments; one side for Electric Utility connections and the opposite side for Customer connections. Compartments shall be separated with an insulating barrier. Size cabinet to maintain necessary wire bending radius in Electric Utility and Customer compartments.
7. All insulating barriers shall be one (1) inch black phenolic resin, NEMA Grade N-1 or XX, or phenolite (Grade GPO-3).
8. Each bus bar shall be copper, minimum 1/4 inch x 4 inches. Drill and tap for six (6) sets of 2-hole compression lugs per bus bar on Electric Utility side or other configuration stipulated by E.U. Lowest edge of all bus bars shall be 36 inches above top of concrete foundation. All bus bar dimensions, quantities, bracing and exact layout shall be per approved details from the Electric Utility for this specific job site. Parallel sufficient bus bars to achieve ampacity shown on Electrical Drawings for both Electric Utility and Customer side of CTB. Drill and tap for 2-hole NEMA D-tang compression lugs for termination of Customer cables.
9. Install CTB level and bolted to a concrete foundation. Locate outside work space clearance and easements associated with Electric Utility padmount transformer and primary ductbank.
10. Cable Termination: Terminate all cables with NEMA-pattern, two-hole, compression lugs.

C. Submittal to A/E: Include at least the following:
1. Manufacturer and Model Numbers
2. Dimensions: plan, elevations, bus bars.
3. Cable Termination Provisions
4. Current Rating
5. Voltage Rating
6. Short Circuit Withstand Rating
7. Bussing Sizes, Layout and Statement of Conductor and Plating Materials
8. Certify weatherproof cabinet construction. Certify paint finish type and thickness.
9. Coordination Drawing showing cable tap box, Electric Utility padmount transformer with required work space clearances, meter location, and underground conduit entrances.
10. After A/E shop drawing cycle is complete, submit three complete copies to Electric Utility.

2.17 ELEVATOR SHUNT TRIP DISCONNECT

A. Provide Bussman Power Module Switch PS Series; amperage size and operating voltage shall match elevator branch circuit indicated on drawings.

B. Provide control power transformer, fire alarm system interface relay, key-to-test switch, mechanical interlock auxiliary contact for hydraulic elevators with automatic recall.

C. Interconnect with local heat detectors to provide elevator shutdown prior to the discharge of fire protection water in elevator machine room.

PART 3 - EXECUTION

3.1 MOUNTING:

A. General: All equipment shall be securely fastened in place.

B. Locations: In all cases mounting locations shall comply with the requirements of the National Electrical Code. This shall include providing suitable working clearances.

C. Concrete Pads:
1. Provide concrete in accordance with the Division of the Specifications for that product.
2. Indoor concrete pads shall consist of a four (4) inch pad with beveled edges extending two (2) inches beyond the perimeter of supported equipment. Switchboards, motor control centers, transformers greater than 15 KVA, and engine generators shall be installed on a pad. Refer to the drawings and the specifications for each piece of equipment to determine what other equipment shall be mounted on a pad.
3. All equipment, ground mounted outdoors, shall be mounted on a pad. Outdoor pads shall be minimum of one foot thick reinforced with #4 rebar one (1) foot on center each way. Size outdoor pads with at least four (4) feet working clearance in front of equipment and one (1) foot on all sides. Provide anchor bolts for pad-mounted equipment. Refer to Detail on drawings.

D. Wall Mounted Equipment: Wall mounted equipment shall be suitably positioned on the wall. Equipment mounted on exterior basement wall shall have unistrut channels between the wall and the equipment to prevent condensation problems. Where wall mounted equipment is specified, but a convenient wall not available, a suitable unistrut mounting stanchion anchored in concrete shall be provided. In lieu of this stanchion, small devices may be mounted on to the equipment served if approved by the equipment manufacturer.

E. Motor rated disconnects: Install disconnects in a vertical orientation with off in the down position.

3.2 DELIVERY, STORAGE AND HANDLING:

A. General:
1. Store all types of electrical power distribution equipment in a clean, heated building affording appropriate physical protection. Control access to prevent unauthorized tampering with the equipment. However, equipment may be stored in other inside or outside environments under approved conditions.
2. Inspect equipment when received at Project site for shipping damage. Report as required by freight carrier to recover repair or replacement costs from the freight carrier in the event damage was sustained.
3. Covers are required unless indoor, ventilated storage conditions exist. Canvas tarpaulins or the equivalent are preferred over other coverings because they provide better humidity control and enclosure scuff protection. Where exposed to moisture, covers shall be waterproof.
4. The manufacturer's shipping skids shall be left on the equipment to provide structural support until the equipment is set in final resting place.
5. Refer to Section 26 05 00 for additional requirements. Contractor shall furnish new equipment to replace any equipment that is exposed to weather or subjected to other deleterious effects of construction.

B. Approved Conditions for Equipment Storage:
   1. General: Where storage conditions specified above are not available, indoor or outdoor storage shall comply with the following.
   2. Switchboards, Motor Control and Other General Distribution and Utilization Equipment:
      a. Store metal-enclosed equipment in the upright position. Provide good ventilation of the shelter and protection from dirt, moisture and physical damage.
      b. Space heaters furnished with the equipment shall be connected to a continuous source of power of the proper rating. Where space heaters are supplied from auxiliary power transformers, care shall be taken that low-voltage heater circuits are properly isolated before power source connection to prevent inadvertent energizing of the auxiliary transformer and associated high-voltage primary wiring.
      c. Ambient conditions may allow condensation inside waterproof covers. If condensation is occurring, temporary heaters or lamp banks shall be provided of sufficient wattage to prevent condensation.
      d. Contractor shall ensure that equipment stored in shipping cases receives adequate ventilation to avoid mildew and prevent condensation.

C. Transformer
   1. Indoor storage shall be provided for all transformers.

3.3 GROUND FAULT PROTECTION OF EQUIPMENT:

A. General: Provide for system performance testing as required by the National Electrical Code. Provide each ground fault relay, sensing device or ground fault protection system with instructions and a test form. The form shall be retained by those in charge of the building's electrical installation and be available to the authority having jurisdiction. The instruction content shall be as required by UL.

3.4 TRANSFORMER VIBRATION ISOLATION:

A. Floor Mounted Transformers: Install on concrete housekeeping pad with Mason Industries Type WM Neoprene Waffle pad, or equal. Provide Type WM isolation for elevated rack installation.

B. Wall Mounted Transformers: Install Mason Industries Type WM Neoprene Waffle pad between the wall brackets and the wall.

C. Suspended Transformers: Install Mason Industries PC30 Pre-compressed spring hanger with neoprene isolator.

D. Floor Mounted Transformers Greater than 150 kVA: Install on Mason Industries, Inc, or equal, unhoused spring isolators with acoustical pad bonded to bottom. Isolators shall be undamped free-standing spring isolators sized for a minimum of two (2) inches of static deflection. The spring outside diameter shall be no less than 80 percent of the spring operating height. The spring shall have remaining travel to solid of no less than 50 percent of the static deflection. Provide a 1/4 inch neoprene friction pad bonded to the spring base. Bolt each vibration isolator unit to concrete pad, and bolt transformers to the vibration isolator units, using the leveling bolts and nuts provided with the unit.

3.5 TRANSFORMER VENTILATION:

A. Transformers with ventilating openings shall be installed so that the ventilating openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer.

3.6 LABELING:

A. Nametag: Provide a nametag for each piece of distribution equipment; see Section 26 05 53, Electrical Identification.

END OF SECTION 26 20 00

SECTION 26 27 26 - WIRING DEVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes wall switches; wall dimmers; receptacles; device plates and box covers. All devices shall be installed in outlet boxes of required size and volume.

1.3 REFERENCES

A. National Electrical Manufacturers Association: Wiring devices shall comply with NEMA Standards WD-1 and WD-6.

B. Wet Locations: Wiring devices and their enclosures installed outdoors and in wet locations shall be approved for that purpose.

C. Minimum Raceway Size: 3/4 inch.

1.4 SUBMITTALS

A. Submit manufactures product data for all wiring devices, indicate intended color and coverplate.

PART 2 - PRODUCTS

2.1 GENERAL

A. All devices shall be suitable for use intended, and have voltage and current ratings adequate for loads being served.

2.2 WALL SWITCHES

A. Single Pole Switch, Toggle Style:
   1. Leviton 1221 Series, 20A, 120/277V.

B. Double Pole Switch, Toggle Style:
   1. Leviton 1222 or 3032 Series, 20A or 30A, 120/277V.

C. Three-way Switch, Toggle Style:
   1. Leviton 1223 Series, 20A, 120/277V.

D. Four-way Switch, Toggle Style:
   1. Leviton 1224 Series, 20A, 120/277V.

E. Indicator Switch, Toggle Style:

1. Leviton 1201 Series, 20A, 120/277V. Switch illuminated when load is on.

F. Locator Switch, Toggle Style:
1. Leviton 1221 Series, 20A, 120/277V. Switch illuminated when load is off.

G. Digital Time Switch:
1. Wattstopper TS-400 digital time switch with optional visual warning to flash lights at 5 minutes and 1 minute prior to time-out.

H. Key lock switches:
1. Provide key lock switches for corridor lighting and other locations indicated on electrical drawings.
2. 20 Amp rated.
3. 120/277 Volt ac rated.
4. Key-lock mechanism can only be turned ON or OFF with key.
5. Single pole: Leviton 1221-2KL or approved equal.
6. 3-Way: Leviton 1223-2kl or approved equal.
7. 4-Way: Leviton 1224-2kl or approved equal.
8. Provide 302 stainless steel wall plate for each switch.
9. Provide 2 keys on ring for each switch.
10. Include a brass tag on every key switch ring. Engrave tag; Example: “Hall East Lights”.
11. Key all switches alike to match the owners standard key. Coordinate with school District for key match.

I. Color: As selected by Architect.

2.3 MOTOR RATED SWITCHES

A. Provide where a switch is indicated as a local disconnect for all mechanical and plumbing equipment.

B. Leviton MMS Series.

2.4 WALL DIMMERS

A. Manufacturers:
1. Lutron Nova "T" Series.

B. Product Description: Semiconductor dimmer for incandescent lamps with ON-OFF switch.

C. Body and Handle: Linear slide handle, color as selected by Architect.

D. Voltage: 120 volts.

2.5 RECEPTACLES

A. Single Convenience Receptacle:
1. Leviton 5362A Series, 20A/125V.

B. Duplex Convenience Receptacle:
1. Leviton 5362 Series, 20A/125V, respectively.

C. GFCI Receptacle:
   1. Leviton GFNT2 Series, 20A/125V.
   2. Provide GFCI receptacles for all receptacles on 120v circuits installed in kitchens, bathrooms and outdoors (including rooftops).

D. Isolated Ground Duplex Receptacle:
   1. Leviton 5362-IG, 20A/125V.

E. Duplex Tamper Resistant Receptacle/ USB Charger
   1. Leviton T5832. Duplex 20A/125V receptacle with two 3.6A, 5VDC, 2.0 Type A USB Chargers.

F. Provide 20 amp receptacle for single-receptacle branch circuits.

G. For locations where a quadruplex or fourplex is required, provide 2-duplex receptacles under common coverplate.

H. Color: As selected by Architect.

2.6 WALL PLATES

A. Type 302 Stainless Steel with matching mounting screws.

2.7 MANUFACTURERS

A. Each type of wiring device shall be furnished by one (1) manufacturer. The following will be acceptable providing the project specifications:
   1. Leviton
   2. Pass & Seymour
   3. Hubbell / Bryant
   4. Cooper

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when connecting wire and cable is abandoned and removed. Install blank cover for remaining abandoned boxes.

B. Maintain access to existing boxes and wiring connections remaining active and requiring access.

C. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

A. Route raceway and cable to meet Project conditions.

B. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

C. Adjust box location up to ten (10) feet prior to rough-in when required to accommodate intended purpose.

D. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.

E. Install devices plumb and level.

3.3 MOUNTING HEIGHTS

A. As indicated on Drawings or if not indicated in accordance with the Architects instructions. All other telephone, Data, TV, etc. outlets shall be same as receptacle.

3.4 GANGED SWITCHES

A. Install permanent barrier between all 277 Volt light switches ganged into one outlet box.

B. Where multiple switches are grouped on one location, install switches under a one piece, multi-gang cover plate.

C. Other telephone, data, TV, etc. outlets shall be same as receptacle.

3.5 GFCI

A. Provide ground-fault circuit-interrupter type receptacles for all 15 and 20 amp receptacles shown on drawings in bathrooms, kitchens, mechanical rooms and outdoors.

END OF SECTION 26 27 26

SECTION 26 43 00 - SURGE PROTECTION DEVICES (SPDs) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Section 16400 – Surge Protection Devices, individually mounted and switchboard mounted. Switchboards: Surge Protection Device integrated in switchboards.

1.3 REFERENCES

A. IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits,

B. IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits,

C. IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.

D. National Electrical Code: Article 285

E. UL 1283 - Electromagnetic Interference Filters

F. UL 1449, Third Edition, effective September 29, 2009 – Surge Protection Devices

1.4 SUBMITTALS

A. Product Data: Submit capacity, dimensions, weights, details, and wiring configuration.

B. Submittals shall include UL 1449 3rd Edition Listing documentation verifiable by visiting www.UL.com, clicking “Certifications” link, searching using UL Category Code: VZCA and VZCA2:

1. Short Circuit Current Rating (SCCR)
2. Voltage Protection Ratings (VPRs) for all modes
3. Maximum Continuous Operating Voltage rating (MCOV)
4. I-nominal rating (I-n)
5. SPD shall be UL listed and labeled as Type 1 or Type 4 intended for Type 1 or Type 2 applications.

C. Upon request, an unencapsulated but complete SPD formally known as TVSS shall be presented for visual inspection.

D. Minimum of ten (10) year warranty Manufacturer's Installation Instructions: Submit installation instructions and connection requirements.

1.5 QUALITY ASSURANCE

A. List individual units under UL 1449 (Third Addition) and UL 1283.

B. Single manufacturer: All equipment of each type shall be the product of one manufacturer.

C. SPD shall comply with NEC Article 285 and shall be permanently marked with the short-circuit current rating of the device.

D. Manufacturer Qualifications: Engage a firm with at least 5 years experience in manufacturing transient voltage surge suppressors.

E. Manufacturer shall be ISO 9001 or 9002 certified.

F. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

G. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept equipment on site in factory packaging. Inspect for damage.

B. Protect equipment from damage by providing temporary covers until construction is complete in adjacent space.

C. Handle and store equipment in accordance with manufacturer’s Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

PART 2 - PRODUCTS

2.1 SURGE PROTECTION DEVICES (SPDs)

A. Manufacturers:
1. Current Technology
2. Liebert
3. Siemens
4. Square D
5. GE

B. Product Description: Surge protection devices for protection of AC electrical circuits.

C. Unit Operating Voltage: As indicated on Drawings.

D. Construction:
1. Finish: Factory finish of baked enamel.
2. Balanced Suppression Platform: Equally distribute surge current to Metal Oxide Varistor (MOV) components to ensure equal stressing and maximum performance. Furnish surge suppression platform with equal impedance paths to each matched MOV.
3. Internal Connections: Hardwired with connections using low impedance conductors and compression fittings.
4. Safety and Diagnostic Monitoring: Equipped with standard overcurrent protection:
   a. Continuous monitoring of fusing system.
   b. Monitor individual MOV's (including neutral to ground). Capable of identifying open circuit failures not monitored by conventional fusing systems.
   c. Monitor for overheating in each mode due to thermal runaway.
   d. Furnish green and red solid state indicator light on each phase. Absence of green light and presence of red light indicates which phases have been damaged. Fault detection activates flashing trouble light. Units not capable of detecting open circuit damage, thermal conditions, and over current will not be accepted.
5. Labeling: Permanently affix UL 1449 (Third Addition) suppression voltage ratings and CSA to unit.

E. Types:
1. Switchboards; locate as integral part of switchboard, coordinate mounting with switchboard manufacturer.
2. Panelboards; locate as stand-alone. Component in housing adjacent to protected panelboard.

F. Protection Modes: For Wye configured system, furnish device with directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For Delta configured system, furnish device with suppression elements between line to line (L-L) and line to ground (L-G).

G. Swithboards:
1. The SPD shall be UL 1449 labeled as Type 1 or as Type 4 intended for Type 1 or Type 2 applications.
2. SPD shall meet or exceed the following criteria:
   a. Maximum 7-Mode surge current capability shall be 300kA per phase.
   b. UL 1449 - Third Edition Revision; effective September 29, 2009, Voltage Protection Ratings shall not exceed the following:

VOLTAGE	L-N	L-G	N-G	L-L	MCOV
208Y/120	800V	800V	800V	1200V	150V
480Y/277	1200V	1200V	1200V	2000V	320V

3. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/347	15%	320V

4. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of -50dB at 100 kHz.

5. Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.
6. SPD shall include a serviceable, replaceable module.
7. SPD shall be equipped with the following diagnostics:
   a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
   b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
   c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
   d. Surge Counter

   No other test equipment shall be required for SPD monitoring or testing before or after installation.
8. SPD shall have a response time no greater than 1/2 nanosecond.
9. SPD shall have a 10 year warranty.

H. Distribution and Lighting Panelboards:
1. Listing requirements: SPD shall bear the UL Mark and shall be Listed to most recent editions of UL 1449 and UL 1283. "Manufactured in accordance with" is not equivalent to UL listing and does not meet the intent of this specification.
2. Listing requirements: SPD and performance parameters shall be posted at www.UL.com under Category Code: VZCA. Products or parameters without posting at UL.com shall not be approved. (To access UL Category Code click on Certifications in the left menu bar of UL's home page. Type "VZCA" into the Category Code search box and click Search.)
3. SPD shall be UL 1449 labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
4. SPD shall be UL 1449 labeled as Type 1 intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
5. SPD shall be UL 1449 labeled with 20kA I-nominal (I-n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
6. Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems
7. If a dedicated breaker for the SPD is not provided in the switchboard, the service entrance SPD shall include an integral UL Recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPD's.
8. SPD shall meet or exceed the following criteria:
9. Minimum surge current capability (single pulse rated) per phase shall be:
   a. Distribution applications:
      1) Siemens Model TPS3 09 with Maximum surge current capability of 100kA per phase

10. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

VOLTAGE	L-N	L-G	N-G
208Y/120V	700V	700V	700V
480Y/277V	1500V	1500V	1500V

UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277V	20%	320V

11. SPD shall include a serviceable, replaceable module (excluding Distribution). (Deletable note: Delete or adjust as appropriate.)
12. Service Entrance SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.
13. SPD shall have a warranty for a period of ten (10) years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.
14. SPDs shall be equipped with the following diagnostics:
    a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
    b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
    c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
    d. Surge Counter

No other test equipment shall be required for SPD monitoring or testing before or after

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify mounting area is ready for equipment.

B. Verify circuit rough-ins are at correct location.

3.2 INSTALLATION

A. Install in accordance with IEEE 1100.

B. Install service entrance suppressors in switchboard.

C. Install suppressors for panelboards adjacent to panel.

D. Install surge counter in face of switchboard.

E. Include surge counter for stand-alone SPD.

F. Install with maximum conductor length of 24 inches. Install suppressor with internal fusing.

G. Provide 30 amp, 3 pole circuit breaker in panelboards to feed SPD.

END OF SECTION 26 43 00

SECTION 26 50 00 - LIGHTING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior luminaires, lamps, ballasts, and accessories. Provide all luminaries complete with all new lamps, completely wired, controlled, and securely attached to supports.

1.3 SUBMITTALS

A. Product Data: Submit dimensions, ratings, and performance data.

B. Photometric data for each luminaire, lamp and ballast. Include indications of all options and accessories as well as finish color.

C. Specification Review: A complete item by item, line by line specification review.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Provide luminaires listed by U.L.
   2. Luminaires installed in outdoor areas unprotected from weather to be U.L. Listed for wet locations.
   3. Insulated ceilings: Luminaires installed into insulated ceilings shall be U.L. Listed Type IC.

B. Certification: Certify that fixtures submittal have trim compatible with ceilings being installed.

C. Concrete for outdoor lighting poles foundations shall be provided per Section 03 30 00 - Concrete.

1.5 EXTRA MATERIALS

A. Provide extra materials for Owners use. All parts shall packaged in suitable carton.

B. Provide ten (10) percent spare lamps of each lamp type. Deliver to Owner in original packaging.

PART 2 - PRODUCTS

2.1 LUMINAIRES

A. Acceptable Manufacture: Provide per Fixture Schedule on drawings.

1. Approved equal: Contractor may submit luminaires from other manufacturers. Contractor shall provide a full set of submittals per paragraph 1.2 of this specification section for Engineer and Architects approval. Contractor must have approved submittals stamped and dated from the Engineer and Architect minimum 10 days prior to bid.

B. Product Description: Complete luminaire assemblies, with features, options, and accessories as scheduled.

C. All luminares shall be new and of specification grade.

D. Manufacturer nomenclature in fixture schedule or otherwise described on the Drawings is given only to show the general fixture series. Contractor shall provide fixture with all required accessories and mounting frame type.

E. Wire guard at fixtures in mechanical, electrical, and high abuse areas.

2.2 FLUORESCENT LUMINAIRES

A. Provide fluorescent fixtures complete with lamp ballast.
1. Housing: Fabricated using 22 gage steel minimum. Housing shall have complete coverage of white paint, 85 percent minimum reflectivity applied by light or powder process, then baked until cured.

B. Fluorescent fixture lenses where required, shall be light-stable 100 percent virgin acrylic, translucent conforming to minimum standards of IES-NEMP-SPI. Lens shall be pattern 12 prismatic unless noted otherwise. Thickness of material shall be nominal 0.125 inches. The lens shall be formed with a minimum of eight (8) ounces of acrylic per square foot.

C. Parabolic fixtures shall have both ballast housing reflector covers installed including fixtures requiring only a single ballast. Static Luminaires: All luminaires shall be static type with no-air-handling functions. Punchouts closed with dampers or AIA-Pattern control blades are unacceptable.

D. Reflectors for compact fluorescent lamps (CFL):
1. All relectors of each type to be from single manufacturer.
2. CFL reflectors shall have low iridescence.
3. Reflector Color: Semi-specular natural aluminum.

2.3 LED LUMINAIRES

A. Quality Assurance
1. DOE Lighting Facts certified.

B. LED Specifications

1. Lumen maintenance of the LEDs has been tested in accordance with IESNA LM-80-08 reporting methodology.
2. CRI:>82 minimum (general); >90 healthcare and retail.
3. SDCM: <2.5 in linear pendants and linear recessed; <3.5 in discrete recessed.
4. R9: .0 (general office/school environments); >50 in healthcare and retail environments.
5. Outdoor luminaires to be rated at a minimum of 40^0 C.

C. Lumen Maintenance
1. Minimum L70 at 50K hours based on TM-21 Addendum A Lifetime report at an ambient temperature of 25^0 C, outdoors at an ambient temperature of 40^0 C.

D. Thermal Testing
1. ISTM testing in accordance to UL 1598-2008.

E. Driver
1. 0-10V enabled.
2. Output Class 2 rated.
3. Dimming range: 5-100%.
4. Constant current.
5. THD @ max load: <20%.
6. Power factor: >0.95
7. Environment protection rating: UL Damp and dry.
8. Approbations: certified to UL8750, UL1310, UL935, CSA-C22.2 No. 250.13-12, CSA 22.2 No. 223.
9. ROHS Compliant

F. Fixture photoetry
1. Conducted by a NVLAP accredited testing lab with IESNA LM 79-08.
2. System flux measured in delivered lumens.

G. Warranty
1. 5 year total system warranty.

2.4 COMPACT FLUORESCENT LAMP BALLAST

A. Manufacturers:
1. CFL ballast shall be furnished by luminaire manufacturer.
2. Manufacturers:
   a. Advance Transformer
   b. ESI
   c. Lightolier
   d. Motorola
   e. Magnetek
3. All CFL ballast shall be solid state electronic type.

B. Efficiency: All ballast shall comply with Public Law 100-357; "National Appliance Energy Conservation Amendments of 1988". Ballast shall be marked with symbol "E-inside-a-circle".

C. Standard: UL Listed, 60 hertz line frequency.

D. CFL Starting Circuit:
   1. CFL lamps 4 pin modified rapid start.

E. Ballast factor of 0.95 minimum.

F. Class P thermal protector

G. Ballast shall have Class A sound rating.

H. Minimum starting temperature indoors: 50 degrees Fahrenheit.

I. Total harmonic distortion of 10 percent or less.

J. Power Factor of 90 percent minimum.

K. Lamp Shutdown Protection: Ballast shall detect lamp fault and disconnect lamp from circuit per NEMA recommendations for CFL lamp shutoff circuits.

L. Warranty: five (5) years.

M. Voltage: Branch circuit voltage connection shall be readily adjustable dual voltage (120/277) ballasts

2.5 SOLID STATE ELECTRONIC BALLAST

A. Manufacturers:
   1. Advance Transformer Standard Series.
   2. Universal Lighting Technologies, Inc.
   3. Howard Industries Precision, Inc.
   4. Osram Sylvania / Motorola Gold Edition
   5. SLI Lighting

B. Product Description: High Frequency Solid State Electronic Program Start ballast suitable for lamps specified, with voltage to match luminaire voltage.

C. Lamp Compatibility:
   1. Ballast shall be two or three lamp type as required by Luminaire quantity.
   2. Ballast shall not reduce the rated life published by the lamp manufacturer.

D. Voltage: Branch circuit voltage connection shall be readily adjustable dual voltage (120/277) ballasts.

E. Inrush Current: Submit ballast manufacturer published data for inrush current for each type of electronic ballast required.

F. Standards:
   1. Power Factor: 0.95 minimum for 20 percent THD models and 0.99 for 10 percent THD models.
   2. Total harmonic distortion, 20 percent or less.
   3. Ballast Warranty: Ballast shall have five (5) year written warranty from date of manufacturer against mechanical or electrical defects under normal conditions of use.
   4. CBM Label: Provide fluorescent ballast comply with Certified Ballast Manufacturers Association (CBM) Standards and carry the CBM Mark on the label.

5. Frequency: 60 hertz line frequency.
6. ANSI Ballast Factor: Minimum ballast factor of 0.85.
7. UL Listed and Class P.
8. When located outdoors provide suitable for starting lamps at 0 Degrees F.

2.6 HIGH INTENSITY DISCHARGE (HID) BALLASTS

A. All recessed HID fixtures shall be thermally protected at the fixture. Remote ballast shall have thermal protection and line fusing.

B. All HID ballast shall be High Power Factor type constant wattage.

C. Ballast Circuit: Shall be magnetic-regulator or auto regulator.

D. Product Description: ANSI C82.4, metal halide lamp ballast, suitable for lamp specified, with voltage to match luminaire voltage.

2.7 FLUORESCENT LAMPS

A. T8 Fluorescent:
1. Lamp Color: Provide NEMA color designated RE 741 lamps. Lamp color temperature shall be 4100 Kelvin with CRI of 75 minimum. Lamp shall have rare earth triphosphor coating.
2. Watts: All lamps shall be reduced wattage energy saving. Provide four(4) foot lamps rated at 32 watts.
3. Reduced Mercury: four (4) foot T8 lamps shall be reduced mercury type. Lamps shall be Philips Alto Series, Osram Sylvania ECO Series or GE reduced mercury with green caps.

2.8 EMERGENCY BATTERY PACKS

A. Provide Emergi-Lite FPSIU series, or approved equal, battery pack for fluorescent fixtures designated to have emergency battery back-up.

B. Fixture shall include lighted push button test switch installed in visible, accessible location adjacent to fixture.

C. Provide unswitched alternating current power source per manufacturer’s instructions.

D. Provide connection to local switch where indicated on drawings, connect such that fixture can be controlled on/off from local switch without discharge of battery.

E. For fixtures designated to have emergency battery pack and be on a contactor controlled circuit, provide unswitched alternating current source ahead of contactor and wiring as required to allow automatic on/off control from the contactor without discharge of battery and local on/off switching where indicated.

F. Battery pack shall provide 1100 lumen output for 90 minutes per 2’x4’ light fixture.

G. Provide integral battery pack for all exit signs where emergency generator power is not available. Battery pack shall provide minimum of 90 minutes output.

2.9 EMERGENCY LIGHTING AUTOMATIC TRANSFER SWITCHES

A. Provide automatic transfer switch on all lighting fixtures shown to be on emergency.

2.10 HID LAMPS

A. All lamps shall be clear unless indicated on the Drawings as phospor-coated or required to be phospor-coated by fixture manufacturer for proper photometric performance.

B. Protect HID Lighting fixtures on the side of the ballast with fuse holder. Size and type of fuse shall be per ballast manufacturer.

2.11 DOWNLIGHT FIXTURES

A. Provide recessed light fixtures with trim rings compatible with the ceiling material where fixture is to be installed.

2.12 COMPACT FLUORESCENT LAMPS (CFL)

A. Provide Lamp with NEMA color RE 835. Lamp color temperature of 3500 Kelvin. Lamp color rendering index shall be 82 minimum.

B. CFL shape shall be triple tube, installed vertical, unless luminaire schedule on Drawings states otherwise. Provide Phillips PL-T Series Amalgam CFL or approved equal.

2.13 ACCEPTABLE LAMP MANUFACTURERS

A. Manufacturers:
   1. General Electric
   2. Osram Sylvania
   3. Venture Lighting
   4. North American Phillips

B. Products shall be produced by manufacturers shown or as scheduled from each type of lighting fixture.

C. Furnish all lamps of each type from the same manufacturer.

2.14 EXIT SIGNS

A. Exit signs shall meet visibility requirements and be listed per UL 924 " Emergency Lighting and Power Equipment". Also shall meet Federal, State and Local Codes.

B. Chevron Directional Indicator: Provide Chevron per NFPA 101 Section 5-10.4.1.2.

C. Product Description:
   1. LED Exit Sign:
      a. Provide exit sign with Light Emitting Diodes (LED) illuminance source. Cover LED with diffuser.

D. Housing: Diecast aluminum with stencil face and matte white paint finish.

E. Input Voltage: 120/277 volt, dual input voltage.

F. EPA Energy Star Label.

G. Wire Guards: Install wire guard on all exit signs installed in gyms, lockers rooms, and athletic wing.

2.15 OUTDOOR LUMINAIRE POLE ASSEMBLIES

A. Outdoor Pole assemblies shall consist of a pole base, pole, luminaire or group and lighting circuit wiring.

B. Diesel Standard: 2000 (IBC) International Building Code. Section 1609 requires wind forces on structure to be determined by the provisions of ASCE 7.

C. Minimum Wind Speed: 120 miles per hour.

D. Metal poles shall comply with NEC 410-15(b).

E. Pole Material: Steel.

F. Pole Shape: Round tapered.

G. Pole finish shall match luminaires along mounting arms and bolt covers. Provide polyester powder coat finish on pole and luminaire, 3 mil thick.

H. Pole accessories to include handhole and cover, full matching anchor bolt cover, anchor bolt kit, template, washers and leveling nuts.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned luminaires, lamps, poles and accessories.

B. Extend existing luminaire installation using materials and methods compatible with existing installation, or as specified.

C. Clean and repair existing luminaires to remain or to be reinstalled.

3.2 INSTALLATION

A. General: All luminaires shall have proper supports.

B. Install suspended luminaires using pendants supported from swivel hangers.

C. Locate recessed ceiling luminaires as indicated on Drawings.

D. Install surface mounted ceiling luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

E. Chain Hung: Unless otherwise indicated all fluorescent fixtures in Mechanical, Electrical and Elevator Equipment Rooms shall be chain hung. Verify exact mounting height with Architect before installing fixtures. Provide pendant hangers when equipment room has fire-resistive ceiling.

F. Suspended Ceilings:

1. Provide means of support for luminaires per NEC 410-36. T-bar clips shall be installed on the luminaire and shall be field secured to the inverted ceiling tees so that the luminaire is securely fastened to the ceiling system framing members.
2. Ceiling tiles shall not bear the weight of luminaires. Surface mount luminaires, recessed downlights, light track, exit signs, etc. shall be supported by proper frames or other attachment to main ceiling system grid or building structure above ceiling.
3. Luminaires shall be centered in ceiling tile.
4. Luminaire shall have flange or trim ring for closure of ceiling cutout or opening.
5. Fire-rated Ceiling Assembly: For Luminaires to be flush-mounted into a fire-rated ceiling or surface mounted to a fire-rated ceiling, install with independent, secure support. Raceway, cable assemblies, boxes and fittings located above a fire-rated floor/ceiling or roof ceiling assembly shall not be secured to, or supported by, the ceiling assembly including the ceiling support wires. Provide an independent means of secure support. Independent support wires shall be distinguishable by color, tagging, or other effective means from those that are part of the fire-rated design.

G. Verify weights and recommended mounting methods of all luminaires with manufacturers. Furnish and install supports. Luminaires weighing more than 30 pounds shall be supported independently of the outlet box.

3.3 LOCATIONS

A. Luminaires shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings and to Architect on jobsite for more exact locations. Coordinate location with all other trades before installation. Coordinate all light fixtures in Mechanical Rooms with the final installed piping and ductwork layouts. Adjust fixture mounting height and location if required so that light output is not obstructed by piping and ductwork.

3.4 FIRE INTEGRITY OF CEILING PENETRATIONS

A. Where ceiling is part of a fire-rated assembly, maintain integrity of that assembly with methods given in Section Electrical Hangers and Supports. Obtain ceiling system UL Fire Resistance Directory Design Number from Architectural Drawings.

3.5 AIMING AND ADJUSTMENT

A. General: All adjustable lighting units shall be aimed, focused, and locked by the Contractor under the supervision of the Architect/Owner. All aiming and adjusting shall be carried out after the entire installation is complete.

3.6 LAMPS

A. Clean all lamps after installation.

3.7 CLEANING

A. Lens: Clean lenses of all luminaires after space is finished and prior to project acceptance.

B. Louvers: Remove plastic bag from parabolic louver luminaires after space is finished and prior to project acceptance. Do not remove bags until luminaires have been cleared by the air-balance subcontractor.

3.8 OUTDOOR LUMINAIRE POLES

A. Pole Base: Do not grout space between pole base plate and top of concrete pole foundation. Leave open to allow water to drain and for pole to breathe. If grout is recommended by pole manufacture in space between pole base plate and top of concrete pole foundation, provide grout with drain hole through grouting.

B. Pole Delivery: Unwrap pole upon delivery to job site, unless otherwise instructed by pole manufacturer. Wrapped poles exposed to weather that show wrapper striping or other deterioration of finish shall be replaced at Contractor expense. Replacement shall be new pole or pole refinished at pole factory.

C. Installation:
1. Poles shall be erected only with luminaire(s) or equivalent damping device, unless otherwise instructed by pole or luminaire manufacturer. Poles installed without luminaires are subject to increased modes of vibration.
2. Do not level pole with shims; leveling nuts above and below pole baseplate provide flexible adjustment and long-term holding of pole position.
3. Provide anchor bolts and pole manufacturer's bolt template prior to concrete formwork for pole bases.
4. Minimum wire size for circuit tap inside pole shall be AWG #12.
5. Install pole base cover. Cover shall rest on top of concrete pole foundation and completely conceal air space under pole base plate.

D. Fusing:
1. Install fuse holder and fuses as noted in pole base detail on Drawings.
2. All ballast-controlled luminaires shall be protected by Bussmann Fuses FNQ with Holders HEB (1-pole) or (2-pole) HEX. Fuse(s) and holder shall be mounted inside pole at handhole. Size of fuse to be recommended by the luminaire manufacturer.

3.9 RFI

A. Provide flexible braided metal electrical bonding strap from grounded housing to door frame of all fluorescent parabolic fixtures in designated rooms. Bonding strap shall be braided conductor designed for field installation to either long door side.

END OF SECTION 26 50 00

SECTION 27 00 00 - BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.01 RELATED WORK

A. The entire drawing and specification package apply to the work specified in the telecommunications sections of the specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.02 SCOPE OF WORK

A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.

B. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems in the newly constructed building, complete in every respect.

C. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the Engineer of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.

D. Provide line-by-line specification review for each Division 27 section annotated to certify compliance or deviation.

1.03 DRAWINGS AND SPECIFICATIONS

A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Engineer for review. No departures shall be made without prior written acceptance of the Engineer.

C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Engineer in writing, shall be performed or furnished. In case the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large scale details govern small scale drawings.

D. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.04 CODES AND STANDARDS

A. All work shall comply with the applicable articles of the National Electrical Code, the National Electrical Safety Code, the National Fire Codes (published by National Fire Protection Association), and City Codes and Ordinances, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these authorities.

B. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.

C. ANSI/TIA:
1. ANSI/TIA-526-7-A (July 2015) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
2. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fiber Cable
3. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology
4. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
5. ANSI/TIA-568.0-D (September 2015) Generic B (supersedes TIA-568-C.0 and TIA-568-C-1)
6. ANSI/TIA-568.1-D (September 2015) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)ANSI/TIA-568.2-D (September 2018) Balanced Twisted-Pair Telecommunications Cabling and Components Standard
7. ANSI/TIA-568.3-D (June 2016) Optical Fiber Cabling Components Standard
8. ANSI/TIA-568.4-D (August 2020) Broadband Coaxial Cabling Components Standard
9. ANSI/TIA-569-E (May 2019) Telecommunications Pathways and Spaces
10. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding
11. ANSI/TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard
12. ANSI/TIA-606-C (June 2017) Administration Standard for Telecommunications Infrastructure
13. ANSI/TIA-607-D (July 2019) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
14. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
15. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems
16. ANSI/TIA-942-B (July 2017) Telecommunications Infrastructure Standard for Data Centers
17. ANSI/TIA-1005-A (May 2012) Telecommunications Infrastructure Standard for Industrial Premises
18. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A
19. ANSI/TIA-1183 (August 2012) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
20. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz - Addendum to TIA-1183

21. TIA-1152 (November 2016) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
22. TIA-1179-A (September 2017) Healthcare Facility Telecommunications Infrastructure Standard
23. ANSI/TIA-4966 (May 2014) Telecommunications Infrastructure Standard for Educational Facilities
24. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)
25. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables
26. TIA-604-18 (November 2015) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16
27. TIA-604-5-E (November 2015) FOCIS 5 Fiber Optic Connector Intermateability Standard- Type MPO
28. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard
29. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
30. TSB-184 (July 2009) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
31. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field
32. TSB-190 (June 2011) Guidelines on Shared Pathways and Shared Sheaths
33. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points
34. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
35. TIA-492AAAE (June 2016) Detail Specification for 50-µm Core Diameter/125-µm Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser-Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing
36. TIA-492AAAB-A (November 2009) Detail specification for 50-µm core diameter/125-µm cladding diameter class Ia graded-index multimode optical fibers
37. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of-Polarization Analysis
38. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques

D. ISO/IEC:

1. ISO/IEC TR 11801-99-01 Information technology – Generic cabling for customer premises: Guidance for balanced cabling in support of at least 40 GBit/s data transmission: Parts 1 and 2
2. ISO/IEC TR 29106 AMD 1 Information technology -- Generic cabling -- Introduction to the MICE environmental classification
3. ISO/IEC 24764 AMD 1 Information technology – Generic cabling for data centers
4. ISO/IEC 11801 AMD 1 AMD 2 Information technology – Generic cabling for customer premises
5. ISO/IEC 15018 AMD 1 Information technology – Generic cabling for homes
6. ISO/IEC 24702 AMD 1 Information technology – Generic cabling – Industrial premises
7. ISO/IEC 14763-1 AMD 1 Information technology – Implementation and operation of customer premises cabling – Part 1: Administration
8. ISO/IEC 14763-2 Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation
9. ISO/IEC 14763-2-1 Information technology – Implementation and operation of customer premises cabling – Part 2-1: Planning and installation – Identifiers within administration systems
10. ISO/IEC 14763-3 Ed 2.0 Information technology -- Implementation and operation of

customer premises cabling -- Part 3: Testing of optical fiber cabling
11. ISO/IEC TR 24704 Information technology – Customer premises cabling for wireless access points
12. ISO/IEC TR 24750 Information technology – Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T
13. ISO/IEC TR 29125 IT Telecommunications cabling requirements for remote powering of terminal equipment

E. BICSI – Building Industry Consultative Services International – Published Standards
1. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
2. ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
3. ANSI/BICSI-003-2014 Building Information Modeling (BIM) Practices for Information Technology Systems
4. BICSI 004-2012, Information Technology Division Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
5. ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
6. BICSI 006-2015 Distributed Antenna System (DAS) Design and Implementation Best Practices
7. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
8. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
9. BICSI – Building Industry Consultative Services International – Manuals
10. Telecommunications Distribution Methods Manual, 14th Edition (2020)
11. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
12. Outside Plant Design Reference Manual, 5th Edition
13. BICSI's ICT Terminology Handbook, Version 1.0
14. Telecommunications Project Management Manual (TPMM), 1st edition
15. Telecommunications Project Management Reference Document (TPMRD), 2nd Edition
16. BICSI's Special ICT Design Considerations, Version 1.0
17. Essentials of Bonding and Grounding, Version 1.0

F. National Electric Codes
1. National Electrical Safety Code (NESC) (IEEE C2-2012)
2. NFPA 70-2020, National Electrical Code© (NEC©)
3. ANSI/IEEE C2-207, National Electrical Safety Code®
4. National Electrical Code (NEC) (NFPA 70)
5. NFPA 72 National Fire Alarm and Signaling Code

G. ASHRAE
1. ASHRAE Standard 90.4P, Energy Standard for Data Centers and Telecommunications Buildings

H. OSHA Standards and Regulations – all applicable

I. Local Codes and Standards – all applicable

J. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.

K. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.

L. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.

M. In any instance where these Specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these Specifications shall take precedence. The codes shall govern in case of direct conflict between the Codes and the Drawings.

1.05 EXISTING UTILITIES

A. The Contract Documents reflect the general location and routing for all telecommunications services known to exist on this project.

1.06 BUILDING CONSTRUCTION AND LAYOUT OF WORK

A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.

B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes and ordinances as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate conduit hangers shall be set before concrete is poured, and proper openings through floors, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.

C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.

D. In areas of existing special ceiling construction the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

PART 2 – PRODUCTS

2.01 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and

that the materials and equipment comply with all Contract requirements.

2.02 STANDARD PRODUCTS

A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.03 MANUFACTURER'S INSTRUCTIONS

A. The Contractor is responsible for furnishing the proper telecommunications equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Engineer in writing of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain from the Engineer instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Engineer.

2.04 RUST PREVENTION

A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.05 STORAGE AT SITE

A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

2.06 CONDITION OF MATERIALS

A. All materials required for the installation of the telecommunications systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being erected and installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.07 NAMEPLATES

A. Factory assembled components and equipment shall be provided with embossed nameplates, securely attached to the equipment with rivets or screws. Nameplates will have information required to specifically identify the equipment in the future such as the manufacturer's name, address, catalog number, serial number, etc. All data on nameplates shall be legible at the time of final inspection.

PART 3 – EXECUTION

3.01 ACCEPTABLE MANUFACTURERS

A. The specifications contain the names of manufacturers which are considered acceptable based on the quality of the product.

B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.

C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material which meet the specifications.

D. The drawings represent the manufacturer's equipment scheduled. The listing of acceptable manufacturers in the specifications is not intended to imply that equipment of these other manufacturers will fit in the space provided or have the same electrical, structural or other requirements as the equipment scheduled. The Contractor must ensure that the equipment provided will meet all project requirements prior to submitting data on that equipment.

3.02 SPACE AND EQUIPMENT ARRANGEMENT

A. Equipment and components shall be installed in a manner to permit access to parts requiring service. Telecommunications equipment shall be installed in such a manner as to allow removal for service without disassembly of adjacent equipment.

B. Large equipment or apparatus which is to be installed in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly protected from damage.

C. Equipment shall have working clearances as required by applicable codes and standards.

3.03 SUBMITTAL AND REVIEW OF MATERIALS

A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain, check, certify, and submit complete Shop Drawings and Brochures from Manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein. Submit Shop Drawings and Brochures in sufficient time so as not to impede the progress of work. Three weeks will be required for the processing of Shop Drawings and Brochures in the Engineer's office, exclusive of transmittal time. This time shall be considered by the Contractor when scheduling submittal data. After the Contract is awarded, the Contractor will advise the Engineer in writing of the schedule for submission of shop drawings and product data and the persons authorized to sign submittal data on behalf of the Company.

B. The Engineer's review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.

C. Before submission of Shop Drawings and Brochures, the Contractor shall certify that each Shop Drawing and each item of material or equipment complies with the Contract Documents for this Project. Such certification shall be made by the Owner, a Partner, a

Corporate Officer of the Contractor, or by a person duly authorized to sign for the Contractor. Unless so certified, Shop Drawings and/or Brochures will be returned for resubmittal. Certifications shall be in the form of rubber stamp impressions or typed letter which states:

I hereby certify that this Shop Drawing and/or brochure and the equipment and material shown on this Shop Drawing and/or Brochure complies in all aspects (except as noted*) with the requirements of the Contract Documents for this Project. I further certify that all data shown herein as to performance, dimensions, construction, materials, and other pertinent items are true and correct.

Name of Contractor_____

Signed_____

Position_____

Date_____

*Refer to exception requirements herein.

D. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: Title of the Sheet or Brochure; name and location of the building; names of the Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and Specifications showing the same work. Shop Drawings and Brochures shall be prepared as follows:

1. Shop Drawings: Drawings shall be newly prepared and not reproduced from the Contract Documents, drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by a draftsman skilled in this type of work. All equipment layouts and similar Shop Drawings shall be drawn to at least 1/4-inch = 1'-0" scale.

2. All Shop Drawings shall indicate the equipment actually purchased. The elevation, location, support points, load imposed on the structure at support and anchor points, shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. All Design Drawing space allocations shall be maintained, such as ceiling height, chase walls, equipment room size, etc., unless proper written authorization is required from the Engineer to change them. All associated equipment shall be coordinated and clearly shown on the Shop Drawings.

3. Brochures: Brochures submitted to the Engineer shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space.

4. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.

E. The submittal format shall follow the Specifications format with a submittal required for each required section. The submittal shall be contained in a three-ring hard back binder. Copies of each submittal shall be three-hole punched and arranged (or folded if required) for the

Engineer's filing convenience. Provide one copy of updated TABLE OF CONTENTS and progressive-tabbed index sheets also for the Engineer's filing convenience.

F. Submittal data for each section must be complete. Partial submittals will not be reviewed. To the greatest extent possible all sections shall be submitted with the first submission. No more than three additional submissions will be allowed to complete the submittal package.

G. Unless a greater number is indicated within Division One of these specifications, submit six (6) copies of all Brochures for review. Submit one (1) reproducible and one (1) blueprint of shop drawings for review. Comments will be made on the reproducible to facilitate copying.

H. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Engineer reserves the right to require the Contractor to furnish items exactly as described in the Contract Documents.

I. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they do not meet the specifications. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Engineer and/or will pay a suitable penalty for the inconvenience experienced by the Owner. This penalty will be set by the Owner based on the particular circumstances.

3.04 SUPERVISION

A. A competent certified foreman or superintendent, approved by the Engineer, shall be maintained at the project site to receive instructions and to act for the Contractor. Once this superintendent has been approved, no change shall be made without approval of the Owner or his authorized representative. The Owner and his authorized representative shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance as required.

3.05 CUTTING AND PATCHING

A. Where it is necessary to cut through walls, floors, or ceilings to permit installation of work under this section of the Contract, or to repair any defects that may appear, up to the expiration of guarantee period, such cutting shall be done under the supervision of the Engineer. The Contractor shall not be permitted to cut or modify any structural members without the written permission of the Engineer.

B. Patching of all openings and repairing of any damage to the work of other trades occasioned by cutting operations, or occasioned by the failure of any part of work installed under this Contract, shall be performed by the trade whose work is involved, and shall be paid for by the Contractor.

C. Openings cut through exterior walls or roofs shall be provided with suitable covers to protect the property or materials involved. Openings cut through walls below grade shall be properly protected to prevent entrance of water or other foreign elements. Openings cut between fire zones or plenums shall be sealed to maintain the fire integrity of the wall or floor. Conduits and cable tray through plenum wall shall be sealed using materials complying with UL 1479, NEC 300-21, and NEC 800-3(C), and shall be UL classified.

3.06 HOISTING, SCAFFOLDING, AND TRANSPORTATION

A. Provide hoisting and scaffolding facilities as required to set materials and equipment in place.

3.07 CLEANING

A. The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish. Debris shall be removed from the site and from any street or alley adjacent to the site.

B. At completion of the project, the Contractor shall remove all tools, scaffolding, and surplus materials. Contractor shall leave the area "broom clean". Before final acceptance, vacuum all panels, cabinets, racks and other equipment enclosures. Wipe clean all fixture lenses and reflectors, all panelboard and switchboard interior and exterior surfaces, being careful to remove all stray paint, construction materials, dust, and particles. Touch-up all marred surfaces to restore existing conditions to those provided by the manufacturer.

3.08 CONDUIT SLEEVES

A. Where conduits pass through walls or floors not on fill, galvanized sheet metal sleeves shall be provided and shall be sealed to prevent air and noise transmission. In walls, they shall be flush with each finished surface. In pipe chases, they shall extend 1-1/2 inches above floor slab and be cemented in a water tight manner. Size of these sleeves shall be at least 1/2 inch greater than outside diameter of the conduit.

B. For conduits passing through outside walls, provide and install galvanized steel sleeves having an inside diameter at least 4 inches greater than the outside diameter of contained conduit. Where these occur in walls having a waterproof coating applied, the sleeves shall have welded flanges to build into waterproofing. When conduits are installed, the annular space between pipe and sleeve shall be effectively sealed, using shredded lead hammered in place or an approved mastic sealer.

C. Pipe and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided for roof penetrations.

3.09 GROUNDING

A. Ground buses shall be provided in each Telecommunications room by Division 16 Contractor unless noted on Contract Drawings.

B. Telecommunications grounding system shall be a single point grounding from the building entrance electrical ground to each Telecommunications room. This Grounding system shall be provided by Division 16 Contractor unless notes on Contract Drawings.

C. All Conduit systems, cabinets' racks, cable trays, protector blocks, SCTP patch panels and/or miscellaneous equipment, etc. shall be grounded by being connected to the common telecommunications grounding system. The conductors shall be a # 6awg solid with a green jacket

3.10 RECEDENCE OF WORK

1. This Contract includes many different systems furnished and installed by different trades. All trades shall coordinate their work with that of all other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping

other trades.

3.11 RECORD DRAWINGS

A. The Contractor shall keep a set of Drawings on the job, noting daily all changes made in these Drawings in connection with the final installation, including exact dimensioned locations of all new and uncovered existing active and inactive utilities outside the building, and shall turn over a clean, neatly marked set of mylar reproducible Drawings showing "as-installed" work to the Engineer for delivery to the Owner. All underground utilities, services, and systems shall be accurately located by the Contractor and dimensioned on the "as-installed" Drawings.

3.12 OPERATING AND MAINTENANCE MANUAL

A. The Contractor shall furnish indexed operating and maintenance manuals with complete technical data for each system, piece of equipment, and material installed under this Contract.

B. Two (2) copies of the manual, bound in hardback binders or an approved equivalent, shall be provided. One copy shall be completed and delivered to the Engineer prior to the time that system and equipment tests are performed. The second copy shall be delivered prior to final acceptance.
1. Provide one (1) operation and Maintenance manual for each building. Provide one (1) as-built floor plan and one CD for each building.

C. The manual shall include the following information
1. Manufacturer's installation instructions.
2. Manufacturer's local representative and/or distributor's name and address.
3. Manufacturer's operating and maintenance instructions.
4. Manufacturer's internal wiring diagrams.
5. Contractor's installation wiring diagrams.
6. Replacement part number listings and descriptions.
7. Framed operating instructions, when required, in individual Specification sections.
8. Warranties and guarantees.
9. Provide an approved submittal at the front of each section.

D. The manuals shall be identified on the cover as "Operating and Maintenance Manual" with additional cover display of the name and location of project, the Owner, the Engineers, the General Contractor, and the Subcontractors installing equipment represented in the brochure.

E. The manual shall have a Table of Contents and shall be grouped in sections according to the sections of Division 27. Each section shall have a copy of the pages of the Specifications covered within the section. Sections shall be organized as follows:
1. Each section in the manual shall identify the grouping of all literature required for the system or equipment included.
2. The contents of each section shall be arranged in the following sequence: First, the approved engineering submittals with complete performance and technical data; second, the manufacturer's installation brochure; third, the manufacturer's operating and maintenance brochure; fourth, the manufacturer's installation wiring diagram; fifth, the Contractor's field wiring diagram, if different; and sixth, the manufacturer's brochure listing replacement part numbers and description.
3. Provide a final section entitled, "Warranties and Guarantees", for all equipment, etc.

3.13 EXISTING FACILITIES

1. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner to enter existing areas. Before beginning work in existing areas, the Contractor shall make necessary arrangements and perform other services required for the care, protection, and in-service maintenance of all electrical, communication, plumbing, heating, air condition, and ventilating services for new and existing facilities. The Contractor shall erect temporary barricades with necessary safety devices to protect personnel from injury, removing all such temporary protection upon completion of the work.

2. The Contractor shall provide temporary or new services to existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

3. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air condition ductwork, and equipment, etc. to provide this access and shall reinstall same upon completion of work.

4. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, the Contractor shall remove and reinstall in locations approved by the Engineer all devices required for the operation of the electrical systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

3.14 DEMOLITION AND RELOCATION

1. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.

2. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Engineer. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Engineer and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at not additional cost to the Owner or the Engineer.

3. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work ad in accordance with standard practice of the trades involved.

4. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities

which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Engineer.

3.15 OUTAGES

1. Outages of services as required by the project will be permitted, but only at a time approved by the Owner. The Contractor shall notify the Owner in writing two (2) weeks in advance of the requested outage in order to schedule required outages. No outages shall be taken unless written approval has first been received from the Owner. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the Contract amount.

END OF SECTION

SECTION 27 10 00 - STRUCTURED CABLING SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Summary of Work:
1. Provide a complete and tested cable distribution system for data interconnections (Local Area Network). The data distribution system shall include fully terminated unshielded twisted pair cables, fiber optic cabling, raceways, conduit, UTP termination devices, data communications outlets, fiber enclosures, patch panels, patch cables, network racks, and other incidental and miscellaneous premises wiring system hardware as required for a complete and usable system. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.

1.2 QUALITY ASSURANCE

A. Acceptable manufacturers:
1. The equipment/products described herein, and furnished per these specifications shall be the product of one manufacturer. All references to model numbers and other detailed descriptive data are intended to establish standards of design performance, and quality, as required.
2. Acceptable product manufacturers shall provide a complete category 6 solution as manufactured by **Panduit only**. No other manufacturers will be allowed.

B. Installer Qualifications:
1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State of Texas and Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry and shall provide a reference list of ten (10) large-scale projects and contact names confirming successful Category 6 premises wiring system installations.
2. All Data Cable Systems installation shall be performed by a (BICSI) Certified - Registered Telecommunications Technician or under the direct supervision of a (BICSI) Certified - Registered Communications Distribution Designer (RCDD).
3. Contractor shall be a current Panduit One^{SM} Partner and at least a Registered Tier level Partner that has completed the Structured Cabling Deployment training (Panduit Certified Installer). A copy of the corporate Panduit manufacturer certification shall be included with all quotes.
4. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing SCS contractor will be allowed for any portion of the SCS scope of work.

C. Pre-Construction Meeting:
1. The successful Contractor shall attend a mandatory pre-construction meeting with individuals deemed necessary by the Owner’s representative prior to the start of the work.

D. Acceptance:
1. The Owner’s representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

E. Warranty:

1. The selected system installer shall be a certified installing contractor of product and hold current certification. Contractor shall provide an end-to-end performance warranty of no less than 20 years. The warranty shall be the maximum provided by the manufacturer. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that ALL Category 6 cable links have been tested bi-directionally (end to end) using a Level 2 tester, per TSB-67, and that all test results conform to the most current TIA/EIA-568-A and/or TSB-67 Link values.
2. The warranty will also cover single mode fiber optic cabling. Performance testing shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, method B.
3. The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ISO/IEC 11801, ANSI/TIA/EIA-568-A, or EN 50173. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.

1.3 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. 2023 National Electrical Code

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 11801 Generic Cabling Standard
   9. EN 50173 Generic Cabling Standards for Customer Premises
   10. ANSI/EIA/TIA 526-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plan.

C. Governing Codes and Conflicts:
   1. If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes and regulations.

1.4 ABBREVIATIONS

A. The following abbreviations are used in this document:

DC	Direct Current
IDF	Intermediate Distribution Frame
MDF	Main Distribution Frame
PBX	Private Branch Exchange

UTP	Unshielded Twisted Pair
STP	Shielded Twisted Pair
SMF	Single Mode Fiber

1.5 SUBMITTALS

A. Project Initiation:
1. Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
   a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer.
   b. Product Literature: Complete manufacturer's product literature for all cable, patch panels, cross-connect blocks, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included.
   c. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
   d. Testing: Proposed Contractor Category 6 UTP cable test result forms, fiber optic cable test result forms and a list of instrumentation to be used for systems testing.

B. Shop Drawings:
1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
   a. Proposed circuit routing and circuit grouping plan prepared by a BICSI certified RCDD (Registered Communications Distribution Designer). The RCDD certification must be current.
   b. Conformance: For items which are being provided exactly as specified, provide a letter stating the item description and model number, and that it is being provided as specified. For items which are not as specified, provide standard manufacturer's cut sheets or other descriptive information and a written description detailing the reason for the substitution.
   c. Provide RCDD certification

C. Project Completion:
1. As a condition for project acceptance, the Contractor shall submit the following for review and approval:
   a. 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.
   b. Inspection and Test Reports: During the course of the project, the Contractor shall maintain an adequate inspection system to insure 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.
   c. 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 in a three-ring binder labeled with the project

name and description (4 copies).

d. As-Built Drawings: As-built drawings will include cable pathways, data outlet locations with correct labeling and MDF location. The as-built drawings will be prepared using AutoCAD version 13 or later. Provide the Owner with one mylar plot of each drawing and two blue line prints of each drawing. Provide the Owner with electronic versions of the as-builts on 2 qty. 8MB thumb drives.

PART 2 - PRODUCTS

2.1 GENERAL

A. Installation: The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.

B. Materials: Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications. All approved equivalent products will be published by addendum ten days prior to proposal for Architect/Engineer to review.

C. Testing: All installed cabling shall be tested 100% good after installation by the Contractor.

D. Ratings: All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows:
CM Communications Cable
CMP Plenum Rated Communications Cable
CMR Riser-Rated Communications Cable

E. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.

F. Cable Lubricants: Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.
1. Approved Products
a. Twisted-pair cable: Dyna-Blue
American Polywater

G. Fire Wall Sealant: Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.
1. Approved Products
a. 3M or
b. Pre-approved equal

2.2 DATA CLOSET (MDF/IDF) CATEGORY 6 TERMINATION HARDWARE

A. Equipment Racks/Cabinets:
1. All locations that require Two post rack shall use – Panduit #R2P6S
2. All locations that require four-post racks shall use – Panduit #AR4P
3. For all locations that require Two-post racks The contractor shall Provide and install

(2) Panduit Double sided Cable managers. (1) for each side.

4. All locations that require a wall mounted Cabinet shall use – Chatsworth 12419-748, 30 in. deep rack.
5. Provide plywood backing to support cabinet and paint to match wall color.

B. Distribution Rack Grounding

All Racks shall be grounded using stranded #6 AWG insulated copper conductor. Connect to service entrance grounding electrode. Provide all required bonding materials and hardware and bond to building grounding electrode subsystem at building electrical service entrance.

1. Approved Products – Ground Terminal Block
   Chatsworth Products, Inc. (CPI) #08009-001
2. Approved Products – Wall Mount Bus Bar (one per MDF/IDF location)
   Chatsworth Products, Inc. (CPI) #10622-010

C. Fiber Optic Patch Panels

Provide (4) duplex fiber patch cords for each run installed. Verify Connection types with the owner prior to purchase

1. Approved Products:
   a. Fiber Adapter Panel
      1. Panduit #FAP6WBUDSCZ OptiCom FAP, OS2, 6 SC Duplex, Blue
   b. Fiber Enclosures
      1. Panduit #FRME1 for 1RU enclosures
      2. Panduit #FRME2 for 2RU enclosures
      3. Panduit #FRME3 for 3RU enclosures

The enclosures used shall provide termination panels for SC type 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” rack mountable. Provide all termination accessories, fiber patch cords, enclosures and test for a complete fiber optic distribution system.

D. Modular Patch Panels: The Category 6 data station cable shall be terminated on a modular patch panel with rear mounted termination hardware. Patch panels shall be 19-inch rack mountable. Workstation patch panels shall terminate all workstation communications outlets. Furnish units that adhere to the performance requirements TIA/EIA-568A standards.

1. Approved Products:
   a. Patch Panels
      1. Panduit 24 Port #CPP24FMWBLY Mini-Com Flush Mount Modular Patch Panels
      2. Panduit 48 Port #CPP48FMWBLY Mini-Com Flush Mount Modular Patch Panels
         a. Refer to district standards for placement of 48-port patch panels. They may be used, but only in certain positions.
   b. Provide cable support bars at the back of all patch panels to provide additional support at rear of rack and panels.
   c. Provide category 6 Jack Modules to terminate 110% of the total cable to each communications closet.
      1. Panduit #CJ688TGBL Mini-Com UTP RJ45 Cat6 TG Jack Module, Black

E. Power Strip: A power strip shall be installed vertically on the back of each data rack.

1. Approved Products
   a. Chatsworth Products, Inc. (CPI) #12848-702

F. Cable Management Panels: Provide cable management panels as required for horizontal and vertical cable management. Provide vertical wire management on ends and in between all racks on entire project.
   1. Approved Products
      a. Horizontal – Panduit NCMHF2 (3") (Provide 1 below each fiber optic enclosure)

      b. Vertical – Panduit PRV6 with PRD6 double hinge doors on the ends of each rack, and Panduit PRV8 with PRD8 double hinge doors in between racks.

G. Network Rack Patch Cables: Cabling Contractor shall provide owner with one (1) Category 6 patch cable for each data drop on entire project. These cables will provide connectivity from the front of the network patch panels to the network equipment provided by owner upon move-in. The patch cables are to be terminated properly with RJ-45 connections on each end with the proper pin-out assignments per project configuration.

   1. Approved Products: **All patch cords shall be manufactured by Panduit.**
      a. Headend patch cable colors shall be:
         1. DATA / NETWORK – BLUE
         2. INTERCOM – WHITE
         3. IP CAMERAS – GREEN
         4. SECURITY – RED
         5. ACCESS POINTS / WAPs – ORANGE
         6. HVAC / BAS – YELLOW
      b. Contractor to provide patch cables for each system as indicated above.
         1. Provide 1' patch cables for MDF / IDF racks 100%
            a. Panduit # UTP28SP1BU (BLUE)
            b. Panduit # UTP28SP1BL (BLACK)
            c. Panduit # UTP28SP1RD (RED)
            d. Panduit # UTP28SP1GR (GREEN)

H. Ladder Rack Assembly
   1. Approved Products: All ladder rack equipment will be manufactured by Chatsworth Products Inc. Use as needed.
      a. 12" Ladder Rack
         1. CPI – 10250-112
         2. CPI – 10250-718
      b. Butt-Splice Kit
         1. CPI – 11301-701
      c. Junction-Splice Kit
         1. CPI - 11302-701
      d. 6" Channel Rack-To-Runway Mounting Plate
         1. CPI – 12121-712
      e. Cable Runway Elevation Kit
         1. CPI – 10506-706
         2. CPI – 10506-712
      f. Wall Angle Support Kit
         1. CPI – 11421-712

I. Data drop labeling

   1. On the rack

      a. XY ##
         1. X is closet designation, MDF = A, IDF1 = B, IDF@ = C
         2. Y is patch panel designation, A = 1, B = 2, C = 3
         3. ## is patch panel port number
         4. Example AA01 designates MDF, Patch Panel A, Port 1.

2. In Classroom

a. XY ## (See the above on rack designations)

3. WAP on rack should be labeled WAP XY##

2.3 CABLE ROUTING/PATHWAY

A. Cable Support System: Cable saddles, bridal rings or J-Hooks shall be used to route all exposed cables (cable not in conduit or cable tray) in open access environments as well as in communications closets.
1. Approved Products
a. Chatsworth Products Inc. (CPI) or
b. ComDangles

2.4 STATION WIRING

A. Wire: The data and voice wire provided for all outlets shall be (Category 6) unshielded twisted pair, four-pair, 24 AWG solid copper conductor, meeting the intent and quality level of the TIA/EIA-568-A Commercial Building Wiring Standard. Refer to floor plan and data outlet legend for number of active data ports to specified faceplates.
1. Approved Products: For all voice and data connections:

All wiring on the project shall be plenum-rated, Category 6, blue in color
Approved Manufacturers
1. Panduit TX6000, Model #PUP6004BU-UY

B. Testing: The Category 6 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.

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.

2.5 STATION HARDWARE

A. Flush Mount Jacks: Flush mount jacks shall be high quality Category 6 RJ45 modular jacks with circuit board construction and IDC style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for Category 6 connecting hardware.

1. Approved Products:
a. Data Inserts
1. Panduit TX6 Category 6 Jack Module, #CJ688TGxx.
2. See 2.2. G. 1. above to match module color to patch cable color for each application.
3. All blank inserts should be gray in color
i. Panduit #CMBIG-X
b. Wireless Access Point Inserts
1. Provide Tile Bridge with box to install AP outlet flush with ceiling.
2. Provide a biscuit with terminated cable for each Access Point, installed above ceiling.
i. Panduit #CBX2WH-AY
3. All blank inserts shall be white in color.
i. Panduit #CMBWH-X

B. Faceplates: Faceplates shall be a 4-port, flush mounted, 110 style, stainless steel in color for

RJ45 outlets at all locations.

1. Approved Products:
   a. 4-Port Single Gang,
      1. Panduit Product Code #CFP4S
   b. Provide wall mounted handset faceplates where applicable for wall mounted phone. Refer to floor plan for locations.
   c. Mounting Straps (where applicable)

C. Workstation Patch Cables: Cabling Contractor shall provide owner with one (1) Category 6 patch cable for each data drop on entire project. Each cable will be factory terminated with RJ45 connections on each end with appropriate pin-out assignments per project configuration.

1. Approved Products:
   All Patch Cords to be manufactured by Panduit.

   a. Cat 6 Patch Cable BLUE in color
      1. All patch cables shall match the installed structured cabling system.
   b. Contractor to provide patch cables for each system as indicated:
      1. 100% - 10’ Panduit #UTP28SP10BU

2.6 FIBER OPTIC CABLING

A. IDF/MDF Intra Building Cabling, Approved Products:
   1. 12 strand, single-mode indoor/outdoor, plenum rated with armored jacket.
      a. Approved Part Numbers
         1. Panduit #FSPP912Y
   2. SC Style fiber connectors, OptiCam SC Duplex Connector, OS12/OS2, Blue
      a. Approved Part Numbers
         1. Panduit #FSC2SCBU
   3. SC-LC duplex fiber optic patch cables.
      a. Approved Part Numbers
         1. Panduit # F92ERANB1SNM001

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: Conduit fill shall not exceed 40%.

F. Damage:
1. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).
2. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.

G. Clean Up:
All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.

3.2 DOCUMENTATION

A. Labels
Coordinate all labeling schemes at headend and on cable with owner prior to permanently installing and testing outlets.

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 on-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.

The following nomenclature should be used when labeling all ports:

All cables being served by MDF closet shall begin with 'MC' all IDF served cables shall begin with 'IC#' (# designated IDF closet number).

Next identification shall note what # data port on patch panel (1 thru 48).

Example:

Outlet from 23rd port of the third patch panel from top of rack located at IDF-2
IC2-P3-23

Outlet from the 5th port of the second patch panel from the top of rack located at MDF
MC-B2-05

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. Spreadsheet:
A laminated, detailed spreadsheet indicating port # and which room outlet it serves shall be mounted to the rack in each communications closet.

3.3 EQUIPMENT RACK CONFIGURATION

A. Equipment Racks: Equipment racks shall be assembled and mounted in locations shown on the Drawings and as detailed. Each rack shall be securely mounted to the floor and braced to the wall with cable tray in accordance with the manufacturer's instructions and recommendations. Racks shall be mounted such that the side rails are plumb with vertical cable management panels. Racks to be located such that future expansion can occur without relocating existing racks. Racks shall be grounded in accordance with NEC requirements.

B. Wire Management Components: Horizontal cable management panels shall be installed directly above and below each patch panel, also 2 per each 48 port patch panel should be left at site to accommodate the switch gear when they are installed. Vertical cable management panels shall be installed on each side of the rack. In instances where more than one rack is installed in a single location, vertical cable management shall be installed between the racks and on either side.

C. Cable Placement: Cable installation in the Wiring Closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing area horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.

D. Cable Routing: Cable shall be routed as close as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the Wiring Closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

E. Installation: All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.

F. Hardware: Provide rack and jack panel hardware as required for all data station wiring.

3.4 STATION WIRING INSTALLATION

A. General:
1. Cabling between wiring closet and workstation locations shall be made as individual home runs. No intermediate punch down blocks or splices may be installed or utilized between the wiring closet and the communications outlet at the workstation location.
2. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than one and one-half inches of unsheathed Category 6 UTP cable at either the wiring closet or the workstation termination locations.

B. Exposed Cable:
1. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed station cable will only be run where indicated on the Drawings.
2. Additional exposed cable runs will require Owner approval, and will only be allowed when no other options exist.

C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair

the Owner's efficient use of their full capacity.

D. Cable Routes:
1. All cabling placed in ceiling areas must be in conduit, cable tray or J-Hooks. Cable 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.
2. Attaching cable to pipes or other mechanical items is not permitted. Use J-Hooks for up to 15 cables (Chatsworth hooks with appropriate brackets). All runs of sixteen (16) or more cables, provide cable rings on 36-inch maximum centers to hang cable. Communications cable shall be rerouted so as to provide a minimum of 18 inches spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling. Grid support wires. Cable runs shall be parallel or perpendicular to building structure. Multiple cables to be bundled together every 6 feet.

3.5 STATION HARDWARE

A. Flush Mount Jacks: Flush mount jacks shall be mounted in a faceplate with backbox.

B. Placement: Where possible, the communications outlet shall be located so that its centerline is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches.

C. RJ-45 Jack Pin Assignments:
1. Pin connections for data station cable outlets and patch panels shall match EIA/TIA 568 modular jack wiring recommendation T568B.
2. Pin connections at data jack panels shall match pin connections at outlets (straight through wiring).

3.6 CABLE TESTING REQUIREMENTS

A. Notification: The Owner and Engineer shall be notified one week prior to any testing so that the testing may be witnessed.

B. Inspection: Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.

C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.

D. Errors: When errors are found, the source of each shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Re-test results must be provided on Owner approved forms and witnessed by Owner.

E. Twisted Pair Cable Testing:
1. At a minimum, the Contractor shall test all station drop cable pairs from Data Closet termination patch panels to outlet device RJ45 jacks. Category 6 products shall be tested for compliance to ANSI/TIA/EIA 568A and ISO/IES 11801 for a Category 6 rated installation. Test equipment used shall meet TIA/EIA TSB-67, Level II

accuracy. Further, the contractor shall have a copy of TSB-67 in their possession and be familiar with its contents.

2. Each wire/pair shall be tested at both ends for the following:
   a. Wire map (pin to pin connectivity)
   b. Length (in feet)
   c. Attenuation
   d. Near end cross talk (NEXT)
   e. Power Sum
3. Test equipment shall provide an electronic and printed record of these tests.
4. Test results for each Category 6 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.

F. Testing: Once installed the cabling will be tested for continuity, shorts and grounds.
1. Cabling:
   a. Continuity – 100% continuity testing is required and will be tested from the MDF/IDF location to each classroom drop. A checklist of each cable and test performed on that cable will be submitted once the testing has been completed.
   b. Shorts – No cable shorts will be permitted on the system. If a short is detected, the connector or cable will be repaired or replaced.
   c. Grounds – No direct ground on the center conductor of the AVDN cables are permitted.
2. System:
   a. Continuity – As tested in the above testing requirements.
   b. Power Readings – A power reading will be required at each drop of each of the cabling systems. A +3 dB to a +7 dB is required at each drop with a common feed signal of + 15 dB into the head end amplifier. These measurements to be taken with an approved field strength meter of know calibration. Test measurements to be performed at low channel, mid-band channel, and high channel to determine cable slope.
   c. Signal Quality – A standard receiver, typical of those used in the system, shall randomly be connected to 10% of the outlets across the system and tuned to a reference channel of known quality. No visible indication of co-channel interference, noise, ghosting, or beat interference may be observed.
   d. Carrier to Noise – Carrier to Noise shall be measured at random outlets representing an average cross section of the drops with an approved field strength meter by the following process. With normal operating levels the field set shall be tuned to each channels visual carrier and the level recorded. The input signal to the head end amplifier shall be removed and the input of the amplifier terminated with a short. Each channel shall be re-measured and the noise levels recorded. The Carrier to Noise measurement is the difference of the two figures.
   e. Documentation of Results – All recorded measurements are to be tabulated and included in the systems documentation manual for reference during maintenance of the system.

3.7 INSPECTION

A. General: Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Designer may inspect before acceptance.

END OF SECTION

SECTION 27 41 13

AUDIO VISUAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Provide all equipment specified well as all miscellaneous parts and materials required for the proper installation of the sound reinforcement system. Any alternates must be approved in writing by architect and maintenance.
B. All applicable equipment shall bear the UL label.
C. Contractor shall have been in the professional pro-audio business for at least five or more years. Contractor shall have installed at least five or more equivalent systems within the county areas.
D. Integrate the local sound reinforcement system with the following systems:

1. Local Area and District Wide Network – data drop by Technology cabling contractor.
2. Fire alarm system – Fire alarm Module and Wiring by Fire alarm Contractor.

E. Refer to Section Div 26 for raceway specification and general requirements.
F. Provide one data outlet to nearest MDF rack.
G. Electrician shall be responsible for all raceway and will coordinate with sound contractor prior to installation.
H. Electrician shall provide dedicated 20-amp 120-volt circuit with ground.

1.2 SUBMITTALS

A. Submit shop drawings as specified.

B. Submit product data on all equipment and cables.

C. Submit a detailed scale drawing of the entire wiring system.

1. Exact routing, quantity, and size of conduit.
2. Exact routing, quantity, size, and type of cables.
3. Exact location of equipment rack.
4. Exact location of all wireless or audio input points

D. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT

1.3 OPERATING AND MAINTENANCE MANUALS

A. Provide Operating and Maintenance Manuals as specified in Div 26 and Division One.

B. Include:

1. An "As Built" block diagram of the system showing how the components are connected and where each is located.

2. Wiring diagram for equipment including point-to-point circuit diagrams.
3. Color code of conductors.

PART 2 – MATERIALS

2.1 SYSTEM COMPONENTS

Conference 1923

A. CFCI
1. Yealink-based BYOD conferencing system
   a. 1 qty. Yealink SmartVision 40 Black #1206656
      - Installed mounted on wall with 1 qty. Yealink TV-Clip Mount #330100057001
   b. 1 qty. Yealink CM20 #1303095 Ceiling microphone
   c. 2 qty. Yealink CS10 #1303094 Ceiling speaker
   d. 1 qty. USB2CAT5E-EXT #1303109 USB extender
   e. 1 qty. Yealink RCH40E2 #1303166 PoE Switch
   f. 1 qty. StarTech #4K70IC-EXTEND-HDMI
      - 1 qty. installed under tabletop
      - 1qty. installed behind LCD
   g. 1qty 10 ft HDMI patch cable for tabletop connectivity
      - Contractor shall provide all requisite patch cables for fully functional BYOD conferencing system.
2. 1 qty. Samsung QM85C Series 85” LCD
3. 1 qty. Chief LTM 01U Mount

Video Review 1954

A. CFCI
4. 1 qty. Clear Touch 6086K+ 86” Interactive Display
5. 1 qty. Chief LTM 01U Mount
6. 1 qty. Chief PAC525 In-wall storage box.
7. 1 qty. Comprehensive CHE-HDWP85UD, HDMI & USB-C Wall Plate Extender Kit – ‘PS’.

Video Room 1958

A. CFCI
   a. 1 qty. Clear Touch 6086K+ 86” Interactive Display
   b. 1 qty. Chief LTM 01U Mount
   c. 1 qty. Chief PAC525 In-wall storage box
   d. 1 qty. Comprehensive CHE-HDWP85UD, HDMI & USB-C Wall Plate Extender Kit – ‘PS’.

Video Review 1959

A. CFCI
   a. 1 qty. Clear Touch 6086K+ 86” Interactive Display
   b. 1 qty. Chief LTM 01U Mount
   c. 1 qty. Chief PAC525 In-wall storage box
   d. 1 qty. Comprehensive CHE-HDWP85UD, HDMI & USB-C Wall Plate Extender Kit – ‘PS’.

Group Instruction 1955

B. CFCI – In addition to Specification 27 51 23.80 – LOCAL SOUND REINFORCEMENT SYSTEMS:
1. 1 qty. Clear Touch 6086K+ 86” Interactive Display

2. 1 qty. Chief LTM 01U Mount
3. 1 qty. Chief PAC525 In-wall storage box.

Weight Room 1927

B. CFCI – In addition to Specification 27 51 23.80 – LOCAL SOUND REINFORCEMENT SYSTEMS:
   4. 4 qty. Samsung QM85C Series 85" LCD
   5. 4 qty. Chief LTM 01U Mount
   6. 4 qty. Chief PAC525 In-wall storage box.

Conditioning 1968

B. CFCI - In addition to Specification 27 51 23.80 – LOCAL SOUND REINFORCEMENT SYSTEMS
   a. 1 qty. Clear Touch 6086K+ 86" Interactive Display
   b. 1 qty. Clear Touch CTI-STAND-ADJM-V4 Adjustable Stand

Team Room 1969

B. CFCI - In addition to Specification 27 51 23.80 – LOCAL SOUND REINFORCEMENT SYSTEMS:
   a. 2 qty. Clear Touch 6086K+ 86" Interactive Display
   b. 2 qty. Clear Touch CTI-STAND-ADJM-V4 Adjustable Stand

PART 3 – EXECUTION

3.01 WIRING AND INSTALLATION TECHNIQUES

a. Coordinate all work with all other trades to avoid causing delays in construction schedule. Contractor shall expedite the delivery of materials and provide additional labor as required to meet construction deadline.

~~b.~~ Coordinate final connection of power and ground wiring to equipment racks by electrical contractor. Power and ground wiring shall terminate inside equipment racks on a standard duplex outlet. Mount as to not interfere with internal equipment of the rack. Power shall be a dedicated circuit and not share with any other source. Ground as per NEC with third wire (green) to panel ground lug at breaker supply panel.

c. All equipment and enclosures described in this specification section shall be plumb and square. All equipment except portable equipment, shall be permanently attached to the structure and held firmly in place. Supports shall be adequate to support their loads with a safety factor of at least three.

d. Wiring and installation under this contract to meet NFPA, NEC, and local code requirements where applicable.

e. The process of equalizing and testing the Audio Sound System may necessitate moving and adjusting certain component parts (e.g., loudspeakers). This shall be done without claim for additional payment.

f. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic hum. Separate all low level microphone and auxiliary inputs from speaker output conductors, data or other system wiring.

g. All wiring shall be labeled as to destination using vinyl wire labeling tags. Use l wire labeling printer. Label input, output and wireless wiring. Label electrical power beaker at electrical panel. Label location of room and power panel/breaker at equipment rack.

h. Label all mixer inputs with their respective location. Example: mixer input 1 - Mic 1 etc. Name to reflect name on engraved wall plate.

i. Paint all back boxes and conduit prior to installation of wiring or connectors. Protect and do not paint any wiring or equipment rack cabinets.

j. Install equipment cabinet in a controlled temp, dry and accessible area. Provide space to open cabinet completely. Equipment not to be in general gym area where it can be damaged.

k. Mount wireless antenna as close to equipment rack as possible. Mount/locate so that it will not be a direct target for gym balls etc.

3.2 INSPECTIONS

A. General: Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/ Designer may inspect before acceptance.

B. Adjust speaker wattage taps to provide clear, uniform sound coverage throughout gymnasium or cafeteria through entire volume range of amplifier, provide limiter circuit and controls on amplifier to prevent over-driving speaker system.

C. Contractor shall use white noise generator and spectrum audio analyzer to set overall frequency response and equalization Limiter(s) shall be set to prevent damage to amplifier and speakers. Amplifier to be set to prevent overdriving from pre-amp. Chamber county maintenance personnel to be on site during process.

D. Demonstrate the performance of the system and give instructions of proper operation and maintenance to the Owner. Provide 2 hrs. Of training and basic system operating instructions - instructions laminated- and affixed to the inside of the front door with appropriate mounting hardware.

3.2 CABLING

A. General: provide the following cable types for the following functions:

1. Category 6 cable for media devices.
2. One pair #14 AWG twisted to sound reinforcement speakers.
3. RG-58U for wireless mic antenna

END OF SECTION

SECTION 27 51 19 - SOUND MASKING SYSTEMS

PART 1 - GENERAL

1.01 APPLICABLE PROVISIONS OF THE CONDITIONS OF THE CONTRACT AND DIVISION #1, GENERAL REQUIREMENTS, GOVERN WORK IN THIS SECTION.

1.02 SUMMARY

A. This specification includes all components required for a fully functional sound masking system for the purpose of increased speech privacy, freedom from distraction, and/or sleep disturbance-reduction in the treated areas.

1.03 DEFINITIONS:

1. Sound Masking System: The electronic equipment and emitters or speakers used to generate, distribute, and control masking sound throughout a treated area.
2. Loudspeaker, Speaker or Emitter: These terms are used interchangeably in this document to indicate a device in the sound masking system which emits masking sound and voice paging or music.
3. Direct Field Masking System: A masking system comprised of emitters or speakers that emit masking noise directly into a masking environment without permeating through an obstruction such as a ceiling or floor tile.
4. Indirect Field Masking System: A masking system comprised of speakers that emit masking noise into a space either above or below the masking environment and permeate into the masking environment through an obstruction such as a ceiling.
5. Hybrid Masking System: A masking system comprised of direct field and indirect field masking systems monitored and controlled by a common network interface.
6. Masking Controller: A networkable electronic device that provides audio feeds to masking emitters or speakers. Audio may include masking noise, background music or paging or a combination thereof.
7. Amplifier: An electronic device required to amplify audio levels from certain masking controllers to drive masking emitters or speakers to a usable sound pressure level.
8. Network: An Ethernet based IP transport to facilitate communications from a PC to the sound masking system or between controllers within a sound masking system. The network must support system configuration, system control and audio transport between devices.
9. Network Switch: A network device when connected to masking controllers allows controllers to share control and audio communications and, when connected to a computer, facilitates setup and control of an entire system from a single connection point.
10. Paging Microphone/Paging Station: When connected to a masking system controller or through a network switch, sends paging messages to one or more masking zones.
11. Zone: One or more emitters or speakers assigned to a masking controller and operating as a group.
12. Spatial Uniformity: A condition where the sound pressure levels throughout a defined space do not vary significantly from a specified sound pressure level.
13. Spectral Uniformity: A condition where the sound pressure in each one-third octave band does not vary significantly from the specified one-third octave sound pressure level.

14. Temporal Uniformity: At a given position, a condition where the average sound pressure level measured over a short time interval does not differ significantly from the average sound pressure level measured over a long time interval.
15. SPL: Sound pressure level in dB re 0.00002 Pa (0.0002 microbar).
16. Target Level Variation: The variation, in decibels, of the equalized overall level or 1/3 octave level used as a target in the masking system.
17. Max Level Variation: The maximum variation, in decibels, of the equalized overall level or one-third octave level allowed in the masking system.
18. Project Manager: The architect, owner's representative, general contractor, or other project manager in charge of the construction and site.
19. Sound Masking System Designer: The person or team responsible for design of the sound masking system.
20. Manufacturer: The company that manufacturers the sound masking system products.
21. Contractor: The company chosen to install the sound masking system. The contractor must meet the qualifications described in Section 1.08.
22. Authorized Dealer: The company chosen to provide all sound masking system products described in Part 2. This dealer must be authorized by the manufacturer to provide, install, maintain, and warrant the products specified herein.

1.04 REFERENCES:

1. ASTM E1130-16 – Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index (Updated).
2. ASTM E1374-18e1 – Standard Guide for Open Office Acoustics and Applicable ASTM Standards (Updated).
3. ASTM E2638-10 – Standard test method for objective measurement of the speech privacy provided by a closed room.
4. ASTM E1573-22 – Standard Test Method for Evaluating Masking Sound in Open Offices Using "A"-Weighted and One-third Octave Band Sound Pressure Levels (Updated).
5. ANSI S1.6 – Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements.
6. ANSI S1.4 – Specification for Sound Level Meters. Calibrated Type 1 or Type 2.
7. ANSI S1.11 – Specification for Octave Band and Fractional Octave Band Analog and Digital Filters.
8. UL 2043 – Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air Handling Spaces.
9. ISO - International Standards Organization
10. NEC - National Electrical Code
11. CSA-Canadian Standards Association
12. CE Code – Canadian Electrical Code as Published by the Canadian Standards Association referencing 24th Edition / 2018.

1.05 DESCRIPTION OF WORK

A. The work of this Section consists of the provision of all plans, materials, labor and equipment and the like necessary and/or required for the complete execution of the sound masking system and related work for this project, as required by the schedules, and keynotes and drawings.

1.06 FUNCTIONAL REQUIREMENTS OF SYSTEMS – THE CONTRACTOR SHALL:

A. Distribute sound masking to all areas as indicated on the project drawings.

B. Locate all active electronic components to be conveniently accessible for service.

C. Supply all sound masking system components from a single manufacturer.

1.07 SYSTEM DESIGN, COMMISSIONING AND EQUIPMENT SUPPLY

A. Sound masking system commissioning shall be performed by:
   1. An authorized dealer's engineer trained and certified by the manufacturer.

B. Equipment and accessories not supplied by the masking system manufacturer that are required for a functional masking system, including cabling and hardware where applicable, shall be supplied by a dealer authorized by the equipment manufacturer.

1.08 INSTALLING CONTRACTOR QUALIFICATIONS

A. The sound masking system shall be installed by a qualified contractor.

B. To be considered qualified for this work, the contractor shall be experienced in the provision of low-voltage electronic systems similar in complexity to those required for this project, and shall meet the following criteria:
   1. The contractor is an authorized dealer for the major product components and is certified by the manufacturer to perform installation, setup, maintenance and warranty.
   2. The contractor has a verifiable history of successful installations of at least three projects of similar scope and size.
   3. The contractor has all applicable business and regulatory licenses and certifications.
   4. The contractor has verifiable financial capability to satisfy any bonding requirements for the project.
   5. When directed by the sound masking system designer, the contractor must provide the necessary personnel experienced in operating the required test measurement equipment outlined herein to configure, test, and calibrate the sound masking system.
   6. During the warranty period, the contractor shall maintain two or more technicians who are certified for the product(s) under warranty as stated in Section 1.13.

1.09 BID SUBMITTALS

A. The contractor shall refer to **Division 00** of this Article.

B. Instructions to bidders: To be considered, bids shall be made in accordance with the architect's instructions to bidders and this article.

C. Examinations: The contractor shall carefully examine the contract documents and, when possible, visit the construction site to obtain first-hand knowledge of existing conditions. Contractors will not be given extra payments for conditions that can be determined by examining documents or by making onsite examinations, and will not be relieved of any obligations with respect to bid.

D. Basis of Consideration: shall consist of the following items: **(Include all that apply)**
   1. Sound masking system Performance.
   2. Sound masking system Functional Capabilities.
   3. Contractor's qualifications per 1.08
   4. Sound masking system Ease of Use / Software Interface
   5. Sound masking system Cost.

E. Submittal Documents
   1. The contractor shall adhere to **Article 01 30 00** for these requirements.
   2. The contractor shall coordinate all submittals with requirements set forth in **Section 01 30 00**.
   3. Unless otherwise directed by contract, the contractor shall not order equipment until the submittals have been reviewed and approved by the specifying consultant.
   4. In keeping with the practices of LEED™, the contractor shall deliver all submittals in electronic format as combined PDF files via FTP posting, CD-ROM, DVD, or e-mail.
   5. All CAD drawings shall be generated in DWG format and also in portable document format (PDF). All other submissions unless otherwise stated shall be provided as PDFs.
   6. The contractor shall provide manufacturer's detailed technical data sheets for all major components in portable document format (PDF).
   7. The contractor shall provide complete floor plan and/or reflected ceiling plan drawing(s) denoting, at minimum, device locations which have been prepared by the sound masking system designer based on the sound masking system manufacturer guidelines.

1.10 INSTALLATION AND QUALITY ASSURANCE

A. Required Permits: The installing contractor or project manager shall obtain all necessary permits for installation work.

B. Project Management: The contractor shall assign a qualified person to manage the installation and maintain the same person in charge of work throughout installation.

C. Contract Documents: The contractor shall maintain a complete set of system drawings and specifications on the job site.

D. The contractor shall install all equipment, cabling, accessories and associated hardware in accordance with the manufacturer's instructions and according to standards of good engineering practice and other conditions as specified by the project manager.

E. Workmanship shall be of professional quality utilizing best commercial practices, and shall be accomplished by qualified personnel.

1.11 JOB CONDITIONS – THE CONTRACTOR SHALL:

A. Refer to and adhere to Division 02 of this Article.

B. Sequencing and Scheduling:
   1. Coordinate work with the project manager and other trades to facilitate construction and prevent conflicts.

2. Afford other trades reasonable opportunity for installation of work and for the storage of materials.
3. Staff the job to keep pace with the other trades. The project manager, at their discretion, may require an increase in the sound masking contractor's staff or require overtime work from the sound masking contractor without additional expenses to the Owner.
4. Abide by the decision of the project manager in case of conflict or interference by other trades.
5. Remove all refuse from the job site daily or per project requirements to the satisfaction of the project manager and owner.

C. Provide insurance on the work of this specialty trade if specified in **Section 00 81 00.**

1.12 INSPECTION – THE CONTRACTOR SHALL:

A. Notify the Project Manager of any defects in work by other trades affecting system installation, operation, or performance.

1.13 WARRANTY – THE CONTRACTOR SHALL:

A. Warrant all equipment to be free of faulty workmanship and defects for a minimum period of five years from date of final acceptance.

B. Warrant the installation of all equipment, cabling, and labor for an initial period of one year from the date of final acceptance unless a longer term is specified elsewhere.

C. Provide owner requested services, including telephone support, at no charge during the duration of the initial one-year warranty period.

D. Provide two semi-annual visits to the site for routine adjustment and maintenance of all specified and installed systems during the initial warranty period and include a preliminary schedule for the semi-annual visits.

1.14 SERVICE CONTRACT – THE CONTRACTOR SHALL:

A. Provide an optional annual service and maintenance contract to commence after the one-year warranty period has expired.

B. Include two semi-annual visits to the site for routine adjustment and maintenance of all specified and installed systems.

1.15 TRAINING – THE CONTRACTOR SHALL:

A. Provide sufficient training to personnel selected by the Owner on operation and basic maintenance of all systems, software, and equipment. Explain operation of control systems, set-up and operation of individual pieces of equipment, and functions of overall systems.

B. Provide manufacturer's operation manuals for all products used in the system.

C. Provide an overall system operation manual for use by the owner's maintenance personnel.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Product requirements shall include all masking, signal generation, signal processing, amplification, and emitters or speakers with associated wiring, software, and controls.

B. Only complete, integrated sound masking systems procured from a single manufacturer shall be acceptable.

C. The sound masking system shall be comprised of logical zones capable of configuration and naming by the sound masking contractor. More than one physical output, including those from multiple control processors may be configured and assigned as a single zone. Each output within the zone may be controlled independently as to masking spectrum and level.

D. The sound masking system shall be capable of automatically scheduling system parameter adjustments, including initial acclimatization, on a per zone basis.

E. Means of control for the sound masking system shall be facilitated through any combination of front panel hardware interface, manufacturer configuration software, and/or a web browser-based software interface.

F. The sound masking system shall generate, amplify, and distribute a minimum of four non-correlated sound masking signals on adjacent emitters or speakers when their spacing is 12’ (3.65m) or less. In this situation, adjacent emitter or speaker devices shall not reproduce coherent sound masking signals.

G. The sound masking system shall be capable of accepting at minimum two external analog microphone or line level audio sources from ancillary audio equipment with control on a per zone basis.

H. The sound masking system zones shall be determined by the functional requirements of each area(s) with separate independent level control for each zone as indicated by the project documents.

I. A new zone with separate level control shall be required in instances where a change in emitter or speaker mounting or ceiling height causes a greater than 0.5dB increase or drop in level or where emitter or speaker density changes from one area to another. This usually translates to a varying device level height of about 6” (152mm) in a typical ceiling environment.

2.02 BIAMP CONTACT AND QUOTE INFORMATION

A. Contractor Shall contact the following BiAmp representative in reference to design and product quantities:

Thad Packard – BiAmp Consultant Liaison – South Central U.S.
Thad.Packard@biamp.com
www.biamp.com – mobile: +1.913.272.6781
Biamp HQ 9300 SW Gemini Drive, Beaverton, OR 97008

Diamp Dallas 5830 Granite Pkwy, Ste 1250, Plano, TX 75024

B. Reference quote number:

QUO-89967-N1Q9 – Galena Park High School Field House – Galena Paek, TX - BI

2.03 SOFTWARE AND CONTROL

A. The sound masking system shall be capable of software control via a TCP/IP local area network connection to the Owner's local area network (LAN Infrastructure). Communication shall be via industry standard Ethernet protocols. No communication via serial or proprietary bus architectures shall be acceptable in this standard.

B. The integrator shall coordinate connection to local area network with Owner's network administrator to include IP Addressing, MAC address(s), switch port assignments, 802.1X and certificate configuration and multirole user authentication passwords.

C. The software interface shall consist of one or more of the following types:
1. Client Based Configuration/Control software utilizing Windows 10 or higher.
2. Internal web server using browser client.

D. Software control of the sound masking system shall include password-protected adjustment and configuration of the following minimum features:
1. Ability to import multiple floor plans to facilitate control of masking zones.
2. Choice of masking controller(s) in the system. The system may include multiple controller types.
3. Choice of emitters or speakers connected to each controller.
4. Pre-optimization of emitter or speaker equalization when applicable for direct field systems.
5. Muting/unmuting per zone.
6. Sound masking level control on a per zone basis.
7. Background music and paging audio input level control.
8. Choice of audio distribution to controller(s) via 802.1X or Dante©.
9. Routing of up to (8) audio sources via a network connection to one or more zones.
10. Equalization adjustment on a per output basis.
11. Emergency mute and push to talk for paging.
12. Zone naming on a per output basis.
13. Time of day scheduling on a per zone basis.
14. Network / clock management.
15. Audio routing of external network audio sources.
16. Error notification / monitoring.

E. The hardware interface shall be capable of basic level adjustment on a per output basis using the front panel menu screen that allows, at minimum, operation of both sound masking and audio input levels.

F. A third-party API shall be published by the sound masking product manufacturer using the RESTful API syntax to allow monitoring of the masking system by building wide / room control system providers.

2.04 PERIPEHRALS

A. Fire Alarm Control Panel
   1. The system controller shall accept a contact closure from a Fire Alarm Control Panel (FACP)
   2. The contact closure shall be configured in the system controller to mute all masking, background music and paging audio in the masking system.
   3. The controller shall communicate with other masking system controllers on the network to also mute their audio when a contact closure is sensed.
   4. The systems shall automatically be restored to normal operation when the contact closure is removed.

B. Paging microphone – to be used only with masking systems designed to support convenience paging.
   1. A balanced, low impedance paging microphone shall be connected to an audio input in the masking controller. 48V phantom power shall be provided by the controller to power the microphone if necessary.
   2. A contact closure shall be accepted by the masking controller to permit the audio from the paging microphone to pass to the page zone(s) as configured from the controller setup software.
   3. The controller shall communicate with other masking system controllers on the network to allow the page audio to be routed to page zones on those masking controllers as configured from the masking system controller setup software.

C. Paging stations – to be used only with masking systems designed to support convenience paging.
   1. The paging station shall be network based utilizing standard 802.1X or Dante© protocols.
   2. The paging station shall be configured as a four- or ten-button keypad version with either a nominal 13.3” (338mm) gooseneck microphone or push-to-talk handheld microphone.
   3. A multi-line LCD screen shall have language support for nine languages and shall indicate the status of the paging station and provide feedback for:
      a. Unlocking the paging station.
      b. Selecting and executing a page code.
      c. Recording messages.
      d. Message playback progress.
      e. Status of a live paging microphone.
   4. A security PIN shall be configurable at each page station to lock out unauthorized users.
   5. The paging station shall have a push-to-talk button with status indication and shall be latchable to support hands-free or long pages.
   6. The paging station shall include DSP to optimize audio playback for the page.
   7. Paging audio shall be blocked from the network until a page is being made for enhanced privacy.
   8. The masking system shall be able to support up to 16 paging stations on the same network.
   9. Each page station shall have the ability to be assigned a priority paging level via software.
   10. The paging station shall be capable of supporting up to (32) page zones. Each page zone shall be comprised of one or more masking zones.

11. Each page station shall have the capability to record, store and play back up to (10) messages. Message length can be variable, with a pool of 50 minutes of record time available. Recordings shall be made at the paging station or downloaded to the paging station through the network via a computer. Recordings may be locked to protect from accidental erasure.
12. A built-in event scheduler shall allow automated playback of any recorded message.
13. The paging station shall include default preannounce tones and shall also support customized preannounce tones.
14. The paging station shall support either desktop or wall mounting.
15. The four-button paging station shall support (4) user configurable page codes.
16. The ten-button paging station shall support (999) page codes.
17. The paging station shall be configured via the masking system controller software.
18. The paging station shall be NRTL listed to UL 62638-1, CSA C22.2 #62368-1, CE marked and shall be RoHS compliant.
19. The paging station shall be TAA compliant.
20. The paging station shall include the manufacturer's five-year warranty.

2.05 CABLE ASSEMBLIES

A. All cable assemblies shall consist of the proper number of conductors, wire gauge, and type, as approved by the system manufacturer based on the system design.
   1. Cabling for 1.25" (32mm) diameter emitters shall be rated either Category 3, Category 5e or Category 6. Cables shall be terminated to TIA568A or TIA568B standards as a "straight-thru" cable.
   2. Cabling for 3" (76mm) diameter or larger speakers shall be a jacketed UTP stranded 18 to 16 AWG cable.
   3. Cabling for 70V speaker systems shall be a jacketed UTP stranded 18 to 16 AWG cable.
   4. Cabling for emitter system power supplies shall be a jacketed UTP stranded 14 AWG cable.
   5. Ethernet cabling shall be UTP Category 5e, Category 6, or Category 7 rated. Cables shall be terminated to TIA568A or TIA568B standards. Each Ethernet cable shall be verified by the Installing Contractor to 10/100 MB/sec standards.
   6. Line Level analog audio cabling shall be a jacketed 2-conductor 22 AWG stranded, twisted pair shielded cable designed for analog audio signals.

B. Cabling flammability rating shall meet the installation conditions as required by NFPA/NEC/CSA or local codes/ jurisdiction as follows;
   1. Type CM – General Purpose for Commercial Installation. Meets UL-1581 requirements for smoke and flammability testing.
   2. Type CMR/FT4 – Commercial Installation for vertical risers. Meets UL-1666 requirements for smoke and flammability testing.
   3. Type CMP/FT6 – Commercial Installation for plenum airspaces. Meets UL-910 requirements for smoke and flammability testing.

C. Terminations shall be completed utilizing the appropriate connector type, method, and tooling as recommended by the product manufacturer.

D. All cabling shall be plenum rated when located in a plenum space.

2.06 LABELS

A. Except where otherwise specified, label each item of control equipment as shown on drawings.

B. Identify all wires and cables at every connection point to controllers with reference number keyed to the as-built wiring diagrams.

C. Room numbers appear on the contract documents for reference only. All labels shall reflect the Owner's final room designations.

D. Cable Markers:
   1. High-grade PVC clip-on or permanent-type cable markers with permanent markings, or printed vinyl tape protected by clear shrink tubing or adhesive wrap shall be used for labelling cabling.

2.07 SAFETY LISTINGS

A. General
   1. Products and system shall comply with all applicable local, regional and national safety codes.

B. Electrical Safety
   1. All electronics shall be UL Listed or listed by an equivalent body such as Intertek ETL. Outside the USA, the electronics shall be certified by an equivalent certification body to meet local and/or national safety standards.

C. Seismic Safety
   1. A ceiling device seismic support system shall be installed in a manner certified by the manufacturer. Alternate seismic support system(s) must be approved by authorities having jurisdiction and based on local code requirements.

D. Fire Safety
   1. The masking control processor shall have the capability to mute or otherwise disable the sound masking signal and any line-level audio input(s) of the entire sound masking system using a dry contact closure from a third party source such as a fire alarm control panel to one of the masking controllers.
   2. The sound masking system shall not be a primary means of emergency voice evacuation or ECS. For this reason, UL2572 compliance is not required under this specification.

2.08 ENVIRONMENTAL CERTIFICATION

A. Sound masking system shall be Green Spec Listed.

B. Sound masking system shall be LEED compliant when project requirements dictate.

PART 3 - EXECUTION

3.01 EXAMINATION – THE CONTRACTOR SHALL:

A. Prior to installation, verify the site is suitable for system installation.

B. Verify all locations where system components are to be installed are free of conflicts with other trades prior to installation.

C. Verify that colors chosen (where applicable) have been coordinated with the architect, building manager, and/or building owner.

D. Verify that site building conditions match the system design plans including ceiling finishes, wall locations, and obstructions. Immediately notify the project manager of any discrepancies prior to the commencement of work.

E. Ensure system power requirements, network connectivity, and any other third party infrastructure requirements for the system have been provided and installed prior to installation.

3.02 DELIVERY, STORAGE AND HANDLING – THE CONTRACTOR SHALL:

A. Protect all system components from moisture, dust and damage during shipping, storage and handling.

B. Deliver in manufacturer's original unopened and undamaged packages with manufacturer's labels legible and intact.

C. Inspect all system components upon receipt and upon unpacking.

3.03 INSTALLATION – THE CONTRACTOR SHALL:

A. General
1. Comply with all applicable electrical and other safety codes.
2. Install the sound masking system in compliance with manufacturer's recommendations and published documentation.
3. Utilize competent workers to install all equipment at locations shown on the drawings in strict accordance with approved shop drawings. Record any and all necessary changes to the system design in cases where different from the submittal documents and submit changes for approval prior to implementing the changes.
4. Ensure that all equipment shall be firmly held in place including emitters or speakers, enclosures, amplifiers, processors, cables, etc. Fastenings and supports shall be adequate to support their loads with a safety factor of at least five unless otherwise stated.
5. Ensure that all system components shall be mounted in a level and plumb fashion utilizing the dimensions indicated on the associated drawings.
6. Mount user controllable devices at a location and height which allows for normal adjustment and operation.
7. Locate all electronics to be conveniently accessible for service.
8. Ensure that all equipment located in the ceiling plenum shall be UL2043 rated for air handling environments.

B. Ceiling Mounted Masking Emitters or Speakers
   1. Locate masking emitter or speaker assemblies as indicated on project drawings and as required to meet the spatial uniformity requirements of this specification.
   2. Ensure that design approval from the sound masking manufacturer is acquired for any direct field masking emitters or speakers scheduled to be installed greater than 20 feet (6.1 M) above the finished floor prior to installation.
   3. Ensure that design approval from the sound masking manufacturer is acquired for any indirect field masking speakers scheduled to be installed greater than 30 feet (9.1 M) above the finished floor prior to installation.
   4. Ensure that the emitter or speaker coverage pattern is not obstructed by building systems or structures which may impede performance of the sound masking system.
   5. Ensure minimum distance between the top of an emitter or speaker and structure/obstacles is maintained to allow adequate clearance of cabling and connectors.
   6. Ensure that the masking emitters and speakers are installed using manufacturer supplied accessories when mounted in other substrates, ceiling types and/or building structures. Sound masking emitter and speaker assemblies shall be mounted to structure in an approved method as required by local codes and jurisdiction, and indicated by the project submittals.
   7. Follow manufacturer recommendations for individual emitter or speaker level controls/taps. Adjust as necessary.

C. Cabling
   1. Install all cabling in a professional, workmanlike manner with adequate service loops where applicable. Cabling shall be dressed in a neat and consistent fashion using appropriate methods and materials.
   2. Test all field fabricated and manufacturer supplied cables, before installation, for open circuits, shorts, crossed pairs, reversed pairs, split pairs and proper pin-out.
   3. Refer to manufacturer recommendations as to maximum cabling distances and types to support control processor unit(s), controls, and emitters or speakers. Manufacturer’s cable distance limitations and quantity of devices per cable run shall never exceed manufacturer guidelines.
   4. Coordinate cabling pathways to prevent conflict with other building systems. Care shall be taken to minimize and eliminate all RFI and EMI interference sources.
   5. Maintain appropriate separation between dissimilar signal types, voltages, and electrical devices.
   6. Install and support cabling in a manner and frequency utilizing approved methods and materials as required by the local AHJ (authority having jurisdiction).
   7. Install cabling in metallic rigid or flex conduit only as indicated on the associated project drawings/specification and using manufacturer approved accessories.
   8. Support all cabling from structure. Cabling shall not contact ceiling tiles or inhibit their removal for access to the plenum.

3.04 SITE QUALITY CONTROL – THE CONTRACTOR SHALL:

A. Ensure that emitter and/or speaker spacing is correct, consistent, and follows design guidelines set forth by the product manufacturer.

B. Securely terminate all cables.

3.05 SYSTEM STARTUP – THE CONTRACTOR SHALL:

A. Coordinate with building network administrator to provide an Ethernet connection to the building LAN where required.

B. Perform the entire product manufacturer's recommended testing and startup procedure as outlined in the manufacturer's product manual(s).

C. Ensure functional operation of all ancillary devices to include front panel controls, audio inputs, contact closures, wall controls, software control and third party controllers. Test each setting and confirm expected results from actions taken. Correct all deficiencies in operation.

D. Perform system startup at a time when each Zone / space is completely vacant and free of any noise contamination.

3.06 SYSTEM TESTS AND ADJUSTMENTS

A. Qualifications of Testing Party
   1. Testing, calibration and setup shall be performed by a qualified manufacturer's employee or an authorized dealer or consultant who has been trained by the manufacturer.

B. Prior to test and adjustment: Ensure the site conditions are suitable for adjustment of the sound masking system. Adjustment can only be made when the following site conditions exist:
   1. All ceiling assemblies are currently installed and completed.
   2. All interior furnishings are assembled and in place.
   3. Mechanical systems have been previously optimized to final operational conditions and are active in areas served by sound masking signals.
   4. No occupants are present at the time of adjustment.
   5. External noise sources (e.g. construction activities) are not present during testing.
   6. Final testing shall be scheduled at least 30 days in advance of owner occupancy.
      a. Notify the party listed under Section 1.07, Paragraph B of this document of the testing and adjustment schedule.

C. Initial test and adjustments: Perform and record results of the following tests:
   1. Masking emitter/speaker operation: Near field output of each masking emitter or speaker shall match the zone average within +/- 2.0 dB. Listen directly below each installed emitter or speaker to confirm it is operating. For any emitter or speakers found to be inoperative, or possibly operating at an incorrect level, use a calibrated sound level meter set to A-weighting and slow response to check the output. Place the microphone so as to contact each grille and measure the variation between a minimum of two adjacent emitters or speakers of the same zone.
   2. Replace any defective emitters or speakers or cabling, or otherwise correct cause for any emitters or speakers found to be operating outside the range stated.
   3. Buzzes, Rattles, and Distortion: With system operating at maximum level, listen for any buzzes, rattles, and objectionable distortion in all areas covered. Correct all causes of these defects.

D. Final test and adjustment: Perform and record the results of the following tests:

1. Control settings: Adjust all masking spectrum levels and audio level controls for initial operation using manufacturer recommended procedures. Document setting for each user control.
2. Adjustment of sound masking Levels: With the masking system active, measure the A-weighted sound pressure level of each Zone independently. Use an ANSI S1.4 approved and calibrated Type 1 or 2 sound level meter and/or calibrated real time acoustic analyzer with one-third octave filters per ANSI S1.11. Perform all SPL measurements at a typical seated height of 4ft AFF (1.2 meters). Adjust the sound masking frequency spectrum in each zone to correspond with the A weighted average level and frequency levels (non-weighted) shown in Table 1. Document at minimum, one measurement per 1000sq ft. in open offices, one measurement in 50% of private offices, and one measurement in 50% of all other spaces where sound masking is present. **All documented measurements shall meet the maximum level variation column criteria of Table 1.** Correct any sound masking system deficiencies such as emitter or speaker placement or speaker tap settings to meet this performance criteria.
3. When integrating the sound masking system in a space previously occupied by workers, configure the incremental level adjustment feature of the control processor. Following the initial adjustment of sound masking levels, adjust each Zone's initial sound masking level to a level 1.5 dBA above the average ambient noise level of the space. Engage the incremental level adjustment feature to automatically increase the sound masking level until reaching the "Average A-Weighted Sound Pressure Level" shown in Table 1 for each type of space listed. Use a minimum time frame of five days for the incremental level adjustment to reach the final target levels.
4. Provide a final testing report which states that the performance requirements of the sound masking system have been met.

E. Automatic real-time masking level adjustment: Automatic adjustment of masking level based on ambient noise conditions shall not be permitted under this specification. Only scheduled adjustment of sound masking levels may occur at times when each zone is vacant of occupants.

F.

TABLE 1 FOR ALL SYSTEM TYPES

Frequency	Open Office	Private Office	Corridor / Conference Room	Max Level Variation - Direct Field & Target Level Variation - Indirect Field	Max Level Variation - Indirect Field
*125 Hz	48 dB	43 dB	46 dB	+/- 3dB	+/- 5 dB
*160 Hz	47 dB	42 dB	45 dB	+/- 3dB	+/- 4 dB
200 Hz	45 dB	40 dB	43 dB	+/- 3dB	+/- 3 dB
250 Hz	44 dB	39 dB	42 dB	+/- 2dB	+/- 3 dB
315 Hz	42 dB	37 dB	40 dB	+/- 1dB	+/- 3dB
400 Hz	41 dB	36 dB	39 dB	+/- 1dB	+/- 3dB
500 Hz	40 dB	35 dB	38 dB	+/- 1dB	+/- 2.5dB
630 Hz	39 dB	34 dB	37 dB	+/- 1dB	+/- 2.5dB
800 Hz	38 dB	33 dB	36 dB	+/- 1dB	+/- 2.5dB
1000 Hz	37 dB	32 dB	35 dB	+/- 1dB	+/- 2.5dB

1250 Hz	36 dB	31 dB	34 dB	+/- 1dB	+/- 2.5dB
1600 Hz	34 dB	29 dB	32 dB	+/- 1dB	+/- 2.5dB
**2000 Hz	32 dB	27 dB	30 dB	+/- 1dB	+/- 2dB
**2500 Hz	30 dB	25 dB	28 dB	+/- 1dB	+/- 2dB
**3150 Hz	27 dB	22 dB	25 dB	+/- 1dB	+/- 2dB
**4000 Hz	24 dB	19 dB	21 dB	+/- 1dB	+/- 2dB
**5000 Hz	19 dB	14 dB	17 dB	+/- 1dB	+/- 2dB
*6300 Hz	14 dB	9 dB	12 dB	+/- 1dB	Not Applicable
*8000 Hz	11 dB	6 dB	9 dB	+/- 1dB	Not Applicable
Average “A” Weighted Sound Pressure Level (dB A)	47 dBA	42 dBA	45 dBA	+/- 2 dBA	+/- 3 dBA

* Denotes additional frequency bands to be used when commissioning systems designed for background music and paging applications.

** For effective speech privacy, special attention must be especially given to these frequency bands to ensure evenness of coverage. If the variation is greater than what is specified above, it is likely that the emitters or speakers are spaced too far apart to meet the above requirements.

[Specifier's Note: The Proof of Performance Section below is optional and can be used in cases where Section 1.07 Paragraph B specifies commissioning by a qualified acoustic consultant. The following section should not be used for dealer / manufacturer commissioned systems.]

G. Proof of performance testing by a qualified Acoustic Consultant: The contractor shall employ the services of a qualified acoustic consultant at no additional cost to the owner documenting to the Owner's Representative in written form that the system is fully operable and is installed in compliance with the terms of the performance specifications hereunder.
   1. Test the system to demonstrate that the design goal of Privacy Index (PI) = 80% (Normal Privacy) or better is met between representative workstations separated by partitions of 66" or greater height. For this test, select adjacent workstation pairs without direct line of sight or significant sound reflecting ceiling or wall elements between, and with a ceiling material rated at NRC of 0.85 or higher. Tests shall be in accordance with ASTM Standard E1130 except that the octave band calculation method of ANSI Standard S3.5 may be used. Lower levels of PI are acceptable only if the ceiling or partition requirements described herein before are not met. Document the results of this test.
   2. Test the system in each open plan area zone served to demonstrate that the design goal for spatial uniformity is met. Tests shall be carried out per ASTM Standard E1573 as measured in the 2,000 Hz octave band. At each location, the average sound pressure levels shall be measured over an interval of at least four seconds at four positions at 90° intervals around a circle of 0.3 m (1 ft.) radius centered on the location. The arithmetic mean sound pressure level shall be calculated from the four measured values. For at least 75% of the test locations, the arithmetic mean sound pressure level in the 2,000 Hz octave band shall not vary by more than +/-1 dB from the average of the arithmetic mean sound pressure levels measured at all locations. Document the results of this test.
   3. Test the system to demonstrate that the Speech Privacy Class (SPC) is at least 75 (Standard Speech Privacy) between representative private (enclosed) offices served by the system. For this test, select adjacent offices with closed doors free of air gaps. Tests shall be in accordance with ASTM Standard E2638-10. Test 10% of all similar sized offices and meeting spaces utilizing the same basic construction methods. Lower levels of SPC are acceptable if the common walls between the offices are comprised of assemblies <=STC 40 and which do not extend to the deck above -or- in cases where the common wall <=STC40, does not extend to the deck, and the ceiling attenuation class of the ceiling material is less than 45 (<=CAC 45). If the SPC achieved is lower than 75 due to architectural factors, bring this to the attention of the Owner or General Contractor. Document the results of this test.
   4. The sound masking contractor will make all necessary modifications to the system design, integration, and/or settings, as specified by the System Designer, to achieve the performance testing goals contained herein at no additional expense to the Owner.

3.07 CLEANING AND WASTE MANAGEMENT – THE CONTRACTOR SHALL:

A. Remove empty packaging and other material waste.

B. Clean all debris created by installation of components.

C. Clean system components where required.

3.08 FINAL CLOSEOUT AND AS-BUILT DOCUMENTATION – THE CONTRACTOR SHALL:

A. Document, prepare and submit all final control processor settings, emitter or speaker zone maps, speaker tap settings, one line diagrams, operational instruction, and testing results in PDF format. Submit three copies to the system designer, the project manager and, if required, the Owner's representative for final review and acceptance.

B. Indicate the location of each sound pressure level measurement, privacy index measurement, and spatial uniformity measurement referenced within the final documents on the zone map.

C. In cases where the sound masking system utilizes configuration software for adjustment and operation, provide a copy on media with each documentation set utilizing the same software version as currently installed and operating. The contractor shall also provide all configuration files created by the configuration software on the same media.

D. With 30-day advance notice, train Owner's designated representative on sound masking system maintenance and proper operation.
   1. Provide user instruction on operation.
   2. Discuss potential for mis-adjustment of sound masking levels and deterioration of both comfort / speech privacy performance.
   3. Demonstrate all software features, controls, and configuration.

3.09 ATTACHMENTS

A. System design schematic: Schematic of the system design on a floor plan showing the quantity and location of system components indicating zoning requirements.

B. Project drawing sheet(s): (insert drawing sheets here)

END OF SECTION

SECTION 27 51 23 – INTEGRATED ELECTRONIC COMMUNICATIONS AND CLOCK NETWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract Documents apply to this Section.

1.2 SUMMARY

A. This section includes a fully operational IP platform for a district-wide internal and school Critical Communications Solution, school safety notifications and general communications including but not limited to the following:

1. Contractor shall only provide new field devices, which shall be integrated back into owner's existing intercom headend.
2. 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.
3. 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.
4. 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).
5. 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.
6. 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.
7. Paging and two-way intercom features shall be accessible from any system console or SIP connected telephone for each campus.
8. The platform shall synchronize its system time to the network timeserver or a web-based time server.
9. Each single campus installation shall be locally survivable for intercom, paging, bells, and emergencies such as lockdown, even when the district connection is unavailable.

10. This specification establishes a minimum level of quality, features, and performance for individual components as well as the integrated system.
11. All cabling shall comply with Division 27 cabling specifications.
12. Systems that do not comply with the feature-sets highlighted in this Specification will not be considered.

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.
   a. 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.
   b. Artwork drawings and lists indicating proposed nameplate nomenclature and arrangements for control panels and plug panels prior to fabrication reflecting equipment used.
   c. 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.
   d. 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.
   a. Record of Owners equipment-programming option decisions.

b. All instructions necessary for proper operation and manufacturer's instructions.
c. "Proof of Performance" information.
d. Manufacturer's maintenance information.
e. 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.
   a. Include with the submittal a preliminary staff development training program in outline form for review and approval by the owner's representative.
   b. 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.
   c. 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.
   d. 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. Any Contractor, who intends to bid on this work and does not meet the requirements of the "Quality Assurance" paragraph(s), shall employ the services of an "Installer" who does meet the requirements and who shall provide the equipment, make all connections and continuously supervise the installation. A subcontractor so employed as the "Installer" must be acceptable to the Architect/Engineer. The "Installer" shall be identified within thirty (30) days of notification to proceed for acceptance by the Architect/Engineer.

C. 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 manufacturers product for it least (10) years, the following is required:
   1. A list of (2) systems manufacturers of which they currently are authorized service providers where the relationship exceeds (10) years.
   2. A letter from the manufacturer outlining the details of changes in service providers over the last (10) years and what actions they will take to ensure continuity of service to the customer.

D. 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.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

F. Comply with NFPA 70

G. Comply with NEMA Standard SB-40 for Emergency Communications in K-12 schools.

H. Comply with UL 60950.

1.6 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 of the staff and faculty members who attended, received, and completed the training program.

1.7 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.

1.8 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide the following system:

1. Telecenter U manufactured by Rauland

a. Authorized Rauland Distributor contact:
Name: Firetron Inc
Address 10101a Stafford Center Drive
Contact: Richard Phillips
Email: rphillips@firetron.com

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. 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.

B. 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.

C. 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.

D. 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.

E. Call-ins may automatically annunciate (display of priority and location) to administrative consoles, SIP enabled phones, and outside phones.

F. Call-ins shall be programmed to automatically change priority and annunciation route based on age of call-in and original priority.

G. Call-ins may have priority (and annunciation route) changed by user action from a console or SIP enabled phone.

H. Call-in annunciation route shall include playing pre-recorded audio over speakers, sending a pre-configured email, and activating relays.

I. The platform shall lend itself to expansion by simple addition of hardware modules.

J. 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.

K. 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.

L. 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.

M. 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.

N. 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.

O. 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. Pre announce tone and supervisory tones shall be disabled during designated emergencies automatically.

P. 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.

Q. 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.

R. 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 annunciate 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 district-wide.

S. Exterior speakers shall be zoned in groups, with a separate signal feed routed to each individual zone. Audio signal routed to each zone shall be controlled by the Owner (MUTE / UN-MUTE). Reference drawings for speaker zones groups. Provide the Owner a simple interface to successfully and easily operate this function.

2.2 EQUIPMENT AND MATERIAL

A. Server Software – Existing in CTE MDF 1807
   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 are able to 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 are able to 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
   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 Button
   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 35 spaces (61") minimum for mounted system equipment.
2. All equipment racks shall be multi-rack format ("gangable") style, bolted together, and open cavity.
3. Equipment rack(s) shall be located in climate-controlled areas/rooms as shown on drawings.
4. All head-end, distribution, and source equipment, including data and power, shall be located in racks configured as approved by the Engineer.
5. Rack mounted equipment shall be accessible from front and rear.

J. Interior Ceiling Speakers
1. Provide Ceiling Speaker Assembly consisting of 8 Ohm, 8" speaker mounted in a 2 foot by 2 foot, or 2 foot by 1 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 CAT6 cable.
3. The speaker shall include provisions to allow attachment of a safety cable if required.

K. Wall Mounted Exterior / Interior Horns, Flush Mount
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 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 and shall comply with Division 27 specifications.
2. UPS equipment will be sized in accordance with the system manufacturer's recommendations.
3. Provide an individual UPS for EACH SYSTEM CONTROLLER (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. EQUIPMENT AND MATERIALS

a. Master Clock Type 1: To UL and cUL 863
   1) Daylight Savings Time pre-programmed via connection to Intercom Controller
   2) Time Zone Pre-set
   3) Non-Volatile Memory
   4) LCD Display for time, date, year, power, time zone and signal reception
   5) Operating Range (32 degrees F to 158 degrees F)
   6) Rack or Shelf Mount
   7) Power Supply Input: 120-volt AC, Output: 12-volt DC, 3 Amps

b. SINGLE FACE DIGITAL CLOCK – SAPLING SERIES SBP 3000
   1) Digital Clock (Powered using PoE)
   2) Maintenance Free.
   3) Five year manufacturer's warranty.
   4) Microprocessor based with RJ45 port.
   5) Heavy Duty Construction
   6) Durable ABS Casing
   7) Clock numbering graphics shall be Digtial
   8) Face of clock is black
   9) Hour and Minute hands shall be red
   10) The clock lens shall use a shatterproof polycarbonate material with no visible molding marks. Glass and/or visible molding marks are unacceptable.
   11) Wire Guard Model in areas where protection is required as indicated on drawings or by owner.

c. DUAL FACE DIGITAL CLOCK – SAPLING SERIES SBP 3000
   1) Digital Clock (Powered using PoE)
   2) Maintenance Free.
   3) Five year manufacturer's warranty.
   4) Microprocessor based with RJ45 port.
   5) Heavy Duty Construction
   6) Durable ABS Casing
   7) Clock numbering graphics shall be Digtial
   8) Face of clock is black
   9) Hour and Minute hands shall be red
   10) The clock lens shall use a shatterproof polycarbonate material with no visible molding marks. Glass and/or visible molding marks are unacceptable.
   11) Wire Guard Model in areas where protection is required as indicated on drawings or by owner.

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 impedance’s 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. Weatherproofing: Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.

3.3 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. 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.

C. 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.

3.4 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.

3.5 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.

3.6 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 owners representative, with at least seven days advance notice.

3.7 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.

3.8 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.

END OF SECTION

SECTION 27 51 23.80 – LOCAL SOUND REINFORCING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

A. Provide all materials, equipment, transportation, and labor to achieve complete and fully functional systems as shown or intended on drawings and in bid specifications.

B. All applicable equipment shall bear the UL label. All work shall be executed in accordance with the National Electric Code (NEC), the Occupational Safety and Health Act (OSHA) and all applicable State and Local codes, ordinances, and regulations.

C. The Contractor's installation team shall have at least one member possessing a NICET Level II, CTS-I or C-EST certification; additionally, at least one audio DSP programmer certified in HiQnet Audio Architect, Symetrix, Biamp Tisera, QSC Q-SYS or Dante.

D. Contractor shall have been in the commercial AVL (Audio, Video, Lighting) installation industry for at least five years. Contractor shall have installed at least five systems of this type and comparable scale in educational facilities within the State of Texas. Contractor shall provide a list of successfully completed projects including completion dates within the past two years from the bid date of this project.

E. Should the local sound systems include Crestron or AMX hardware which requires programming, the Contractor shall provide a Certified Crestron Programmer or an AMX Certified Expert (ACE) Programmer to program, upload and debug the third-party control systems.

F. Should the local sound systems include managed network devices, the Contractor shall provide one person on the installation team with valid certification in one of the following: Harman HCNA/P, CompTIA Network+, Cisco CCNA or Cisco CCNP. Provide valid certification credentials in the submittal documentation.

G. Any discrepancy in quantity or part numbers between the drawings and the bid specifications shall be brought to the attention of the Consultant for clarification during the bidding period. No allowance shall be made to the Contractor by reason of failure to have brought said discrepancies to the attention of the Consultant prior to award of contract. Should discrepancies be discovered, the greater in quality and quantity shown shall be provided.

H. Systems to be installed but not limited to the following areas per Part 2:

1st Floor – Weight Room 1927
2nd Floor – Group Instruction 1955, Conditioning 1968, Team Room 1969

1.2 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. 2015 National Electrical Code

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:
1. If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes and regulations.

1.3 ABBREVIATIONS

A. The following abbreviations are used in this document:
a. UCI = User Control Interface
b. DSP = Digital Signal Processor

1.4 SUBMITTAL DOCUMENTATION

A. Submit shop drawings as specified in pdf format, ARCH E1 (30x42). Contractor shall be responsible for costs associated with producing and submitting all required documentation.

B. Submit a room-by-room list of all equipment to be installed, in pdf format.

C. Submit Manufacturer's product data for all equipment with a table of contents, in pdf format.

D. Submit a line-item compliance statement indicating that the products being submitted comply with the specified equipment and indicate which products deviate from the specifications.

E. Submit detailed drawings of all systems, minimum scale 1/8" = 1', in pdf format.

1. Table of Contents.
2. Rigging details. All hardware must meet or exceed a safety factor of 5:1. Detail the product manufacturer, part numbers and load capacity of all hardware to be used. **Contractor shall employ the services of a professional structural engineer licensed to practice in the State of Texas to verify load ratings of hanging components. Provide attachment details on Shop / Submittal**

Drawings reviewed by said engineer. Include stamped report of items reviewed by structural engineer with shop drawings submittal. Report shall include an itemization of items reviewed by the structural engineer and confirmation that proposed methods of suspending equipment as shown on the shop drawings conform with required safety factors.

3. Floor Plans, Reflected Ceiling Plans and Section Elevations displaying loudspeaker locations and orientation, wall plate locations, rack locations, 120vAC receptacle locations and all other related device locations.
4. Comprehensive system schematics displaying detailed connections to all equipment. These shall display wire numbers, terminal block numbers, patch bay assignments and color coding.
5. Proposed construction details for any custom fabricated items; including interface panels, patch panels and wall plates. These shall display dimensions, materials, finishes, I/O connector labels and color selection.
6. Rack elevations displaying the locations of all equipment within each rack.
7. Riser diagrams displaying conduit requirements with pull boxes, outlet boxes, cable layouts, cable type part numbers and quantity of cables with part number in each conduit.
8. Electrical power requirements for the systems. Include diagrams for any remote control of electrical power displaying locations and elevations for all receptacles in detail sufficient to coordinate with the Electrical Contractor.
9. All submittal drawings not meeting the above criteria shall be deemed incomplete, shall not be reviewed and shall be returned for revision.

1.5 OPERATING AND MAINTENANCE MANUALS

A. Provide Operating and Maintenance Manuals as specified in Division 26 and Division One and deliver to the Owner.

B. Include:

1. Product Data.
   a. Manufacturer's data for each type of product conforming to the submission format specified herein. Include manufacturer's serial numbers within the list of product.
   b. For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
   c. Each product's Owner Instruction Manual. Provide high quality copies where necessary, with all text legible and illustrations of equal resolution and sharpness as the original manual. Faxed copies or copies with portions of the information missing or smeared are not acceptable.
   d. Manufacturer's maintenance and care instructions.
   e. Separately bound list by manufacturer and model or part number of product incorporated within the systems arranged in alphanumeric order. Manufacturer's warranty statements bound separately where applicable.
2. A complete as-installed (As Built) equipment list, listed by room, identifying manufacturers' names, model numbers, serial numbers, quantities and locations of each item.
3. Complete and correct As Built systems schematics, floor plans, reflected ceiling plans, elevations, rack risers and I/O plate details. Include diagrams or charts displaying final settings of all control knobs in the system (mixers, equalizers, audio amplifiers, etc.).
4. Each individual system's program software / source code (audio, video, lighting and third party control) with final settings and pass codes and As Built AutoCAD files (2013 or newer) shall be saved onto two separate 8GB thumb drives and

included in the close-out documentation. All software programs / source codes are the intellectual property of the Owner.

5. Quick-start Guide for each system written with the assumption that the intended reader is technically inexperienced and unfamiliar with the facility. The Quick-start Guide shall be laminated and affixed to the inside of the front door of the system rack with appropriate mounting hardware. One copy of each individual system schematics printed in ARCH D (24x36) and laminated shall be delivered to the Owner.
6. Two hard copy, paper sets of the as-installed (As Built) drawings in ARCH E1. Drawing sets shall be individually bound.
7. In addition to the hard copy close-out documentation, all close-out documentation shall be included, in pdf format, on the, 8GB thumb drives.
8. Service & Maintenance Manual:
   a. Provide an original manufacturer's copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. On equipment where there is no service manual, provide statement from company indicating manual is not available. Arrange manuals in the same order as the operations manual.
   b. Manufacturer's maintenance and care instructions.
   c. Maintenance Instructions, including maintenance phone numbers and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
9. Organize documents into separate bindings containing data relevant to operation, maintenance, and warranty.

1.6 WARRANTY AND SERVICE

A. The Contractor shall warrant all new equipment to be free of defects in materials and workmanship for not less than one year after the Substantial Completion date.

B. The systems are to be free of defects and deficiencies and are to conform to the drawings and specifications as to kind, quality, function, and characteristics. The Contractor shall repair or replace defects which may occur in labor or materials within the warranty period without charge to the Owner.

C. Within the warranty period, respond to requests for service within 24 hours. Service calls to perform warranty work shall be made within 72 hours of request by the Owner. Temporary, equivalent replacement equipment shall be provided at no cost to the Owner when immediate on-site repairs cannot be made.

D. This warranty shall not void or replace individual manufacturer warranties which extend past this warranty period. This warranty shall not void any rights guaranteed the Owner by law.

E. The Contractor shall include in the close-out documentation a certificate of warranty which includes the start and end dates of the warranty and contact information, including name, telephone number and email, of individuals to perform warranty service.

F. This warranty shall not apply to existing Owner Furnished Equipment.

G. Additional warranties may be negotiated between the Contractor and the Owner at the Owner’s discretion.

1.7 SUMMARY OF WORK

A. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.

1. Reference project drawings for locations, quantities, and coordination with other trades.

B. All local sound racks shall have cabling installed and routed according to industry standard best practices. Contractor shall employ horizontal lacing rails in the rear of the rack for neat and orderly cable routing. Use Velcro strips for cable bundling. ZIP TIES ARE NOT ACCEPTABLE.

C. Contractor shall perform an RF scan and shall provide results in pdf format with the close-out documentation. Contractor shall provide an RF coordination sheet, documenting all RF frequencies in use in each system, to ensure there is no RF interference between systems. Coordinate with General Contractor and for access to existing locations.

D. Contractor shall tune each system's DSP to provide a flat frequency response.

1. Tune and set dynamics on all inputs to provide the highest level of gain before feedback while providing intelligibility of all inputs.
2. Contractor shall perform a "rattle test" of all systems: Apply sine wave sweep signal to each loudspeaker system with a two-minute sweep from 20Hz to 550Hz, to 10 - 15dB below full system output. Annotate issues discovered during sweep test. Correct issues resulting from the new system equipment and / or rigging hardware.

E. Contractor shall provide all required equipment and programming to provide a fire alarm override. All audio shall mute in all local sound systems during a fire alarm.

F. Contractor shall provide all cabling, connectors, components and equipment required for a complete and functional system.

PART 2 – MATERIALS

A. All equipment shall be new and unused unless otherwise noted.

B. Contractor shall provide all necessary patch cables, riser/plenum cabling and connectors interconnecting all equipment to provide for fully functional systems. In addition, all cabling raceway, support systems, sleeves and any other materials required to properly install and support cabling systems.

C. All equipment quantities shall be as shown on drawings unless otherwise noted.

D. All materials are to be provided as specified. No substitutions shall be accepted without written request from the Contractor and written consent of the Consultant.

2.12 FIRE ALARM OVERRIDE

A. Provide for Fire Alarm Override for each Local Sound system. Contractor shall provide all cabling, relays, mounting hardware and any other devices (Fire Alarm System devices by others) to provide a fully functioning Fire Alarm Override system. When Fire Alarm is active, each Local Sound System shall be muted. When Fire Alarm ceases, each Local Sound System shall automatically revert to normal operation.

2.13 SCHOOL INTERCOM PUBLIC ADDRESS OVERRIDE

1. Provide for School Intercom Public Address Override for each Local Sound System. Contractor shall provide and install (1) RDL TX-70A, 70v to Line level converter.

Contractor shall provide, install and terminate cabling to nearest School Intercom speaker and shall integrate devices into local sound system. Provide DSP programming to duck Local Sound System to give priority to the School Intercom PA System. Coordinate with Building Intercom Contractor for integration of systems

2.14 CABLE ROUTING/PATHWAY

A. Cable Support System: All audio-video cabling shall be installed and supported using a cable support system at 4'-0" intervals unless installed in conduit. Do not exceed manufacture recommendation for the quantity of cables supported in an individual support.
B. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.

2.15 AUDIO-VIDEO SYSTEM WIRING AND TERMINATING HARDWARE

A. Cabling:

1. Provide a complete audio/video cabling solution from back of each faceplate to device I/O locations as designated on the contract drawings. Each cable provided shall be installed with a minimum of 10' of excess slack above each outlet location. Contractor shall properly support and label all cabling at each outlet.

2. Contractor shall ensure all cabling requirements are met to provide fully functional A/V systems, specified cabling notwithstanding.

3. Contractor shall provide data, video, usb, audio and fiber patch cables for each system.

    a. Data patch cables – Provide Panduit TX6A-28™ patch cables on a per-port basis.
    b. Video patch cables – Provide Extron HDMI Ultra series patch cables for each video field device and rack equipment. Provide Extron HD Pro Plenum Series optical patch cables where applicable.
    c. USB patch cables– Provide Extron USB A-B and C series patch cables for all field devices and rack equipment.
    d. Audio patch cables - Provide Whirlwind MK4 series microphone patch cables for all field devices with microphone inputs/outputs on a per port basis.

2.16 AV SYSTEM SCHEDULING, MONITORING AND CONTROL

1. Contractor shall program the QSYS control system to automatically shutdown system everyday at midnight 12am CST and recall a default configuration. This includes putting all amplifiers in standby, projectors lamped off, lifts, shades and projector screens raised, video walls and displays put into standby.

2. The contractor shall program a UCI for the District Systems Administrator to access from a district computer with QSYS UCI Viewer, password protected.

3. This UCI shall provide all system diagnostics including but not limited to, system wide device health, network audio metering, ptz camera feeds, network video streams per room, display, projector and projector lift status; with the ability to control each rooms UCI remotely.

4. The contractor shall provide the district with QSYS Reflect Enterprise Manager professional tier services during the warranty period for all systems and peripherals.

2.17 GROUP INSTRUCTION 1955

A. LOUDSPEAKERS
   1. 2 qty. QSC AC-C8T - white, full range ceiling loudspeakers.
      a. 8 Ohm Operation

B. VIDEO PROJECTORS

   1. 1 qty. Epson #V11HA35920, EB-PU1006W – WUXGA, 6,000 lumens projector
      a. With Epson #V12H004M0F, ELPLM08 lens
      b. Verify proper lens throw distance prior to installation
      c. Provide all required mounting hardware and adapters
         i. Chief MFG #SYSAUWP2
         ii. Chief adjustable pole mount.

C. PROJECTION SCREEN

   1. 1 qty. DaLite Tensioned Advantage Series SKU# 20327.
      a. 110” Diagonal Screen.16:9 Aspect Ratio. White housing.
      b. Flush mount in ceiling. Provide all applicable mounting hardware including but not limited to all-thread, back-to-back Unistrut, etc. to ensure all applicable NEC, UL, state, and local plenum mounting codes.
      c. Suspended to Joist by all-thread and cross-joist back-to-back Unistrut for position adjustment. Coordinate with Structural to determine proper mounting hardware.
   2. 1 qty. DaLite DL16622 Smart Low-Voltage Wall Switch (white)

D. SIGNAL PROCESSING, CONTROL, AND PERIPHERALS

   1. 1 qty. Comprehensive CHE-HDWP85UD, HDMI & USB-C Wall Plate Extender Kit – ‘PS’.
   2. 1 qty. RDL RU-PA40D 40 W Stereo Audio Amplifier
   3. 1 qty. 3.5mm TRS to Phoenix Connection cable.
   4. 1 qty. MTX Audio MUSICAVC-100Z for ‘VC’ (L) volume control.
      a. Machine label as “LOCAL VOLUME”

E. INTERACTIVE DISPLAY - SMBD

   3. CFCI – Refer to Specifications 27 41 13 – AUDIO VISUAL SYSTEMS for materials.
      a. SMBD shall connect with local system via HDMI output to PS plate when needed for projections. Typical use shall be laptop into PS plate when projection is needed.

2.18 WEIGHT ROOM 1927

A. LOUDSPEAKERS

   1. 9 qty. QSC AD-S8T - black, 10-inch 2-way wall-mounted loudspeakers.
      a. Tap each speaker at 60 watts.
      b. 9 qty. AD-S8T X-mounts (1 per speaker)
      c. Split signal output of amplifier between 4 speakers for one leg, and 5 speakers for second leg.

B. AMPLIFIERS

1. 1 qty. CX-Q 4K4, Network amplifier.

C. DSP, CONTROL AND PERIPHERALS

1. 2 qty. QSC TSC-70-G3, 7" Touch screen controller.
   a. 1 qty. Honeywell CG512A1009 Large Thermostat Guard in gym space.
   b. 1 qty. in weight room coordinator office 1905
   c. Provide 5 sets of keys.
2. 1 qty. QSC Core 24f. – Mounted in IDF 1960
   a. Lan A for QLan/Dante, Lan B for internet (GPISD LAN) access.
   b. Coordinate with the District IT department to provide internet access.
   c. Provides DSP for Weight Room 1927.
3. 1 qty. QSC UCI Deployment license.
4. 1 qty. QSC Scripting license.
5. 1 qty. QSC 32 X 32 Dante license.
6. 1 qty. QSC Microsoft Teams license.
3. 1 qty. Attero Tech unD6IO-BT, double-gang US Bluetooth Wall Plate Interface
4. 1 qty. Comprehensive CHE-HDWP85UD, HDMI & USB-C Wall Plate Extender Kit – 'PS'.
   a. Install receiver in IDF 1960 Rack 2 (AV) and connect to QSC NV-21-HU.
5. 5 qty. QSC NV-21-HU video endpoint.
   a. 4 qty. Installed as HDMI video decoder at (1 qty. each) wall-mounted LCD screens in weight room.
   b. 1 qty. Installed in IDF 1960 Rack 2 (AV) as decoder for CHE-HDWP85UD Receiver.
6. 2 qty. QSC QIO-LVR4 (for relay control of motorized window shades)

D. AUDIO NETWORK

1. 1 qty. M4250-26G4F-PoE+ (GSM4230P) 24x1G PoE+ 300W 2x1G and 4xSFP Managed Switch
2. 1 qty. CommScope 760162800 | UNP-6A-DM-1U-24, 24 Port Cat6a Patch Panel.

E. PLATES, PANELS AND DISPLAYS - All custom wall plates shall be manufactured by ProCo, RCI or Whirlwind. Anodized aluminum, BLACK with white lettering in 1/8" Sans Serif font.

1. ANTENNA PLATE, "W1".
   a. ProCo 2 gang anodized plate, black with 1 qty 50 Ohm BNC connectors and 1 qty Atlas Sound AD-12BE.
   b. Quantity and locations as shown on drawings.

2. ASSISTED LISTENING ANTENNA PLATE, "H".
   a. ProCo single gang antenna plate with 1 qty. 50 Ohm BNC connector.
   b. Quantity and locations as shown on drawings.

3. TELEVISION PANELS IN SPACE, "LCD"
   a. CFCI – Refer to Specifications 27 41 13 – AUDIO VISUAL SYSTEMS for materials.
      i. Contractor responsible for Cat6 cabling from IDF 1960 to LCD plates in space.

F. WIRELESS MICROPHONES

1. 1 qty. Shure ULXD4D-G50, Dual channel digital wireless microphone receiver.
2. 1 qty. Shure ULXD2SM58-G50, wireless microphone handheld transmitter.
3. 1 qty. Shure ULXD1-G50, wireless microphone bodypack transmitter.

4. 1 qty. Shure SM31FH Fitness headset microphone.
5. 1 qty. Shure WA360 mute switches.
6. 1 qty. Shure SBC200, 2 bay charging station for wireless microphone transmitters.
7. 2 qty. Shure SB900B, rechargeable wireless microphone batteries.
8. 2 qty. Shure UA8-470-636 – black, ½ antenna.

H. ASSISTED LISTENING SYSTEM

1. 1 qty. LS-54-216 Assisted Listening System
2. 1 qty. LA-124 antenna. Install at locations shown on drawings.
3. Provide enough LR-4200-216 Receivers to meet TAS and ADA standards as required by law.
4. Provide with each additional LR-4200-216 Receiver:
    a. 1 qty. LA-401 Ear Speaker.
    b. 1 qty. LA-430 Earphone/Neck Loop Lanyard
5. Provide 1 qty. LA-124 antenna.
6. Coordinate with Architect for installation location of each LA-304 Signage Kit.

I. EQUIPMENT RACK AND ACCESSORIES – LOCATED IN IDF 1960

1. 1 qty. Middle Atlantic PDX-920R-SP, Rackmount Power, 9 Outlet, 20A with Series Surge Protection.
2. 1 qty. Middle Atlantic UPS-2200R, Rackmount Uninterruptible Power Supply 1650W.
3. Install all rack mounted equipment with Middle Atlantic HTX, T20 Star Post,10-32 security-screws.

J. USER CONTROL INTERFACE / TOUCH PANELS

1. Coordinate with Owner and Consultant for final UCI functionality and layout. Coordinate with Owner for Logo to be displayed on all UCI pages. Provide a numeric (0-9) passcode page immediately after the splash page. Provide a simple way for Owner to change and store new password from the UCI.

2. CONTROL PANEL UCI

    a. The first page “SYSTEM START UP” shall have the text, “PRESS ANYWHERE TO START SYSTEM”. The next page shall display a prompt requesting a passcode. Once the passcode is entered correctly, a System Start Up loading bar shall be visible. After the system has booted, the next page “HOME”, shall allow for the selection of auto mode, manual mode, media controls and system shutdown.

    b. The “AUTO MODE” page shall include a system mute button, master output volume control fader with buttons to allow the user to navigate back to the home page or a system shutdown page. In this state, a priority ducker shall be applied to lower background music sources to the priority input of the microphone gym instructor microphone with no more than a 10ms attack time and no less than a 500ms hold time. The sources being ducked shall be within a range of -6dB to -12dB volume reduction.

    c. The “MANUAL MODE” page shall include a system mute button, channel fader volume controls, preamp controls and mutes for all available inputs, auxiliary buss assignments with buttons to allow the user to navigate back to the home page or system shutdown page.

    d. The “MEDIA CONTROLS” page shall provide transport controls for the Media

player, interfaces for all available internet radio apps, Bluetooth pairing and allow the user to navigate back to the Auto mode, Manual Mode or Media Controls page.

e. The “VIDEO CONTROLS” page shall automatically power on the displays, close any automatic shades when pressed and route the HDMI source from the ‘PS’ to all associated destinations. Provide buttons to allow the user to navigate back to the home page or system shutdown page.

e. When system shutdown is selected, a prompt shall appear with the text “PLEASE CONFIRM SHUTDOWN”. The user will then select a button labeled “Yes” or “No”. If no is selected, the “HOME” page shall appear. If yes is selected, a system shutdown loading bar shall appear. All amplifiers and video displays/projectors shall be put in standby mode, and projector screens/lifts raised. Once the system shutdown sequence is complete, the “SYSTEM START UP” page shall be visible.

2.19 CONDITIONING 1968, TEAM ROOM 1969

A. LOUDSPEAKERS

2. 18 qty. QSC AC-C8T - white, full range ceiling loudspeakers.
   b. Tap each speaker at 60 watts.

B. AMPLIFIERS

1. 1 qty. CX-Q 4K4, Network amplifier.

C. DSP, CONTROL AND PERIPHERALS

1. 3 qty. QSC TSC-70-G3, 7” Touch screen controller.
2. 1 qty. QSC Core 24F.
   a. Lan A for QLan/Dante, Lan B for internet (GPISD LAN) access.
   b. Coordinate with the District IT department to provide internet access.
7. 1 qty. QSC UCI Deployment license.
8. 1 qty. QSC Scripting license.
9. 1 qty. QSC 32 X 32 Dante license.
10. 1 qty. QSC Microsoft Teams license.
11. 3 qty. Attero Tech unD6IO-BT, double-gang US Bluetooth Wall Plate Interface.
12. 3 qty. Comprehensive CHE-HDWP85UD, HDMI & USB-C Wall Plate Extender Kit – ‘PS’.
    a. Install receiver in associated local sound rack and connect to QSC NV-21-HU.
13. 9 qty. QSC NV-21-HU video endpoint.
    c. 3 qty. Installed as HDMI video decoder at (1 qty. each) ceiling mount projector.
    d. 3 qty. Installed as HDMI video encoder in local sound rack (1 qty. each) for “PS” video input.
    e. 3 qty. Installed as HDMI video encoder in plenum above or adjacent tile to projector for (1 qty. each) Crestron AirMedia.
    f. Provide HDMI cables.
14. 3 qty. Crestron AM3200 AirMedia Receiver 3200 (1 qty. for each divisible room)
    a. Installed in plenum above or tile adjacent to projector.
1. 2 qty. Legrand Partition Sensor (1 qty. for each partition)

a. Provide all required external power supplies and required hardware to make functional triggering of 3-room divide/combine with Q-Sys Core 24f Processor.

2. 3 qty. QSC QIO-LVR4 (1 qty. for relay control of each motorized projection screen.)
   a. Coordinate with electrical contractor for contact closure control of shades. Control shall be integrated with touch panels.

D. AUDIO NETWORK

1. 1 qty. Netgear M4250-26G4F-PoE+ (GSM4230P) 24x1G PoE+ 300W 2x1G and 4xSFP Managed Switch
2. 1 qty. CommScope 760162800 | UNP-6A-DM-1U-24, 24 Port Cat6a Patch Panel.

E. VIDEO PROJECTORS

2. 3 qty. Epson #V11HA35920, EB-PU1006W – WUXGA, 6,000 lumens projector
   a. With Epson #V12H004M0F, ELPLM15 lens
   b. Verify proper lens throw distance prior to installation
   c. Provide all required mounting hardware and adapters
      i. Chief MFG #SYSAUWP2
      ii. Chief adjustable pole mount.

F. PROJECTION SCREEN

2. 3 qty. DaLite Tensioned Advantage Series SKU# 20331.
   1. 184” Diagonal Screen.16:9 Aspect Ratio. White housing.
   2. Flush mount in ceiling. Provide all applicable mounting hardware including but not limited to all-thread, back-to-back Unistrut, etc. to ensure all applicable NEC, UL, state, and local plenum mounting codes.
   3. Suspended to Joist by all-thread and cross-joist back-to-back Unistrut for position adjustment. Coordinate with Structural to determine proper mounting hardware.

3. User Connectivity Patch Cables:
   a. Contractor shall provide one of each patch cables for each Presentation Station wall plate.
   b. 15ft USB C to C Cable, Extron USBC Pro/15, # 26-741-15
   c. 15ft HDMI cable, Extron HDMI Ultra/15, # 26-663-15.

G. INTERACTIVE SMARTBOARD DISPLAYS - MSMB
   1. CFCI – Refer to Specifications 27 41 13 – AUDIO VISUAL SYSTEMS for materials.

H. WIRELESS MICROPHONES

1. 1 qty. Shure ULXD4Q-G50, QUAD channel digital wireless microphone receiver.
2. 1 qty. Shure ULXD2SM58-G50, wireless microphone handheld transmitter.
3. 3 qty. Shure ULXD1-G50, wireless microphone bodypack transmitter.
4. 3 qty. THOR Hammer SE headset microphone.
5. 2 qty. Shure SBC200, 2 bay charging station for wireless microphone transmitters.
6. 4 qty. Shure SB900B, rechargeable wireless microphone batteries.
7. 1 qty. RF Venue DFINB – black , diversity antenna.

I. PLATES AND PANELS - All custom wall plates shall be manufactured by ProCo, RCI or Whirlwind. Anodized aluminum, sliver with black lettering in 1/8” Sans Serif font.

1. ANTENNA PLATE, “W”.
   a. Double gang anodized plate, black with 2 qty 50 Ohm BNC connectors and 1 qty Atlas Sound AD-12BE.
   b. Quantity and locations as shown on drawings.

2. ASSISTED LISTENING ANTENNA PLATE, “H”.
   a. Single gang antenna plate with 1 qty. 50 Ohm BNC connector.
   b. Quantity and locations as shown on drawings.

J. ASSISTED LISTENING SYSTEM

1. 3 qty. LS-54-216 Assisted Listening System
2. 3 qty. LA-124 antenna. Install at locations shown on drawings.
3. Provide enough LR-4200-216 Receivers to meet TAS and ADA standards as required by law.
4. Provide with each additional LR-4200-216 Receiver:
   a. 1 qty. LA-401 Ear Speaker.
   b. 1 qty. LA-430 Earphone/Neck Loop Lanyard
5. Transmitter installed in Storage 1967 local sound rack.
6. Coordinate with Architect for installation location of each LA-304 Signage Kit.

K. EQUIPMENT RACK AND ACCESSORIES

1. 1 qty. Middle Atlantic DWR35-26, pivoting wall mount rack.
   a. Installed in STORAGE 1967.
2. 2 qty. Middle Atlantic PDX-920R-SP, Rackmount Power, 9 Outlet, 20A with Series Surge Protection.
3. 1 qty. Middle Atlantic UPS-2200R, Rackmount Uninterruptible Power Supply 1650W.
4. 1 qty. Middle Atlantic Products SS, 1RU Heavy duty sliding shelf.
5. 1 qty. Middle Atlantic D2LK – 2RU Locking Drawer
6. 1 qty. Middle Atlantic FI-3
7. 1 qty. Middle Atlantic DWR-FK6-26 Fan Kit.
8. 1 qty. Middle Atlantic BR2 Brush Plate.
9. 1 qty. Hoffman A121236T1T Nema Type 1 Wiring Trough.
   a. Installed by Electrical contractor
10. Install all rack mounted equipment with Middle Atlantic HTX, T20 Star Post,10-32 security-screws.
11. Provide 5 extra front door keys to the Owner.
12. Provide front door.
13. Populate all unused rack spaces with blank panels.

L. USER CONTROL INTERFACE / TOUCH PANELS

1. Coordinate with Owner and Consultant for final UCI functionality and layout. Coordinate with Owner for Logo to be displayed on all UCI pages. Provide a numeric (0-9) passcode page immediately after the splash page. Provide a simple way for Owner to change and store new password from the UCI. Provide audio and video room combining functionality when the airwall is in operation.

2. CONTROL PANEL UCI

   a. The first page “SYSTEM START UP” shall have the text, “PRESS ANYWHERE TO START SYSTEM”. The next page shall display a prompt requesting a passcode. Once the passcode is entered correctly, a System Start Up loading bar shall be visible. After the system has booted, the next page “HOME”, shall

allow for the selection of auto mode, manual mode, media controls, video controls and system shutdown.

b. The “AUTO MODE” page shall include a system mute button, master output volume control fader with buttons to allow the user to navigate back to the home page or a system shutdown page. System shall detect active input with hierarchy dependent upon ‘PS’ input as main input. Should no signal be present, Airmedia will take over. Should Bluetooth audio be present, sound will default to that input with range of -6dB to -12dB ducking with 500ms hold time to microphone sources.

c. The “MANUAL MODE” page shall include a system mute button, channel fader volume controls, preamp controls and mutes for all available inputs, auxiliary buss assignments with buttons to allow the user to navigate back to the home page or system shutdown page.

d. The “MEDIA CONTROLS” page shall provide transport controls for media control purposes, interfaces for all available apps or associated playback control functions, Bluetooth pairing and allow the user to navigate back to the Auto mode, Manual Mode or Media Controls page.

e. The “VIDEO CONTROLS” page shall automatically power on the display or projector and drop the projector screen/lift, and route the HDMI source from the ‘PS’ to all associated destinations. Provide buttons to allow the user to navigate back to the home page or system shutdown page.

f. The “DIVIDE/COMBINE” page shall provide selection of the 3 room spaces between Team Room 1969 and Conditioning 1968 as one functioning system, or two independent systems, or 3 independent systems. Functionality shall be for failover in cases where partition sensor is not detecting open or closed partitions for auto divide/combine.

g. When system shutdown is selected, a prompt shall appear with the text “PLEASE CONFIRM SHUTDOWN”. The user will then select a button labeled “Yes” or “No”. If no is selected, the “HOME” page shall appear. If yes is selected, a system shutdown loading bar shall appear. All amplifiers and video displays/projectors shall be put in standby mode, projector screens/lifts raised and shades opened. Once the system shutdown sequence is complete, the “SYSTEM START UP” page shall be visible.

PART 3 – EXECUTION

3.1 WIRING AND INSTALLATION TECHNIQUES

A. Coordinate all work with all other trades to avoid causing delays in construction schedule. Contractor shall expedite the delivery of materials and provide additional labor as required to meet construction deadline.

B. Coordinate final connection of power and ground wiring to equipment racks by electrical contractor. Power and ground wiring shall terminate inside equipment racks on standard duplex outlets. Mount as to not interfere with internal equipment of the rack. Power shall be a dedicated circuit and not share with any other source. Ground per NEC with third wire (green) to panel ground lug at breaker supply panel.

C. All equipment and enclosures described in this specification section shall be plumb and square. All equipment except portable equipment shall be permanently attached to the structure and held firmly in place. Supports shall be adequate to support their loads with a safety factor of at least five.

D. Wiring and installation under this contract to meet NFPA, NEC, and local code requirements where applicable.

E. The process of equalizing and testing the Audio Sound System may necessitate moving and adjusting certain component parts (e.g., loudspeakers). This shall be done without claim for additional payment.

F. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic hum. Separate all low level microphone and auxiliary inputs from speaker output conductors, data or other system wiring.

G. All wiring shall be labeled using vinyl wire labeling tags. Use Brady^{tm} model BMP21 or equal wire labeling printer. Label input, output and wireless wiring. Label electrical power beaker at electrical panel. Label location of room and power panel/breaker at equipment rack. Protect labels with clear heat shrink.

H. Label all mixer inputs with their respective input. Example: mixer input 1 – “Mic-1”, etc. Label to reflect name on engraved wall plate.

I. Solder all microphone connections using rosin core solder. Use temperature controlled soldering equipment. Microphone XLR connectors shall use standard wiring code as follows: pin 1 shield/ground, pin 2 positive, pin 3 negative.

J. Paint all back boxes and conduit prior to installation of wiring or connectors. Protect and do not paint any wiring or equipment rack cabinets.

K. Install equipment cabinet in a controlled temperature, dry and accessible area. Provide sufficient space to completely open the front and rear of the cabinet. Equipment not to be in general gym area where it can be damaged.

3.2 CABLING

A. General: Unless otherwise noted, provide the following cable types (or equivalent) for each application:

1. West Penn 454 #22 AWG twisted pair / shielded for Microphone and Line level signals.
2. West Penn C210 #10 AWG twisted pair for subwoofer / low frequency speakers.
3. West Penn 227 #12 AWG twisted pair for conventional, full range sound reinforcement speakers.
4. West Penn 226 #14 AWG twisted pair for 70v sound reinforcement speakers.
5. West Penn 810 RG-8 coax cable for analog RF signal lines.
6. West Penn 4246 CAT6 cable for Local Sound/Video Network and Dante digital audio devices.
7. West Penn 4246F F/UTP CAT6 for digital audio snake devices.
8. West Penn 4246AF F/UTP CAT6A cable for HDBaseT video devices.

9. Crestron CRESNET.

10. Corning 006TSP-T4180D20 multi-mode fiber optic cable for drop face plate connections.

    a. Provide Corning 95-050-99-X LC fiber connectors for multimode terminations.

    Corning 006ESP-T4101D20 single-mode fiber optic cable for network switch interconnections.

    a. Provide Corning 95-200-99 LC fiber connectors for single mode terminations.

11. Provide plenum rated cable where required.

3.3 INSPECTIONS

A. General: Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/ Designer may inspect before acceptance.

B. Ensure all systems are installed to provide uniform, balanced audio coverage throughout each intended listening area. Ensure there are no rattles, buzzes, hums, RF interference, electro-static interference, feedback or other audible audio anomalies while the systems are in operation.

C. Contractor shall use white / pink noise generator and audio spectrum analyzer to set overall frequency response and equalization. Ensure gain structure is properly set to prevent clipping on any device and to provide balanced system functionality. Provide proper limiter programming to prevent damage to all audio components. District Maintenance personnel to be on site during process.

D. Demonstrate the performance of each system and give instructions of proper operation and maintenance to the Owner. Provide a minimum of eight hours of training and basic system operating instructions for each system in not more than four hour sessions. Include a list of system training attendees in the Close-Out Documentation.

1. Contactor shall record each training session with a 720p, minimum, digital video recording device, with audible audio, in .MOV or .MP4 format and compile sessions onto 128MB thumb drives (as many as required) (SanDisk, Kingston or PNY) and provide to Owner. Contractor shall title each video file with the room name of the system and date; e.g., “Dining Commons – August 15, 2019.”

2. Contractor shall provide an asbuilt QSYS designer file, Dante Controller preset, Shure wireless work bench inventory/RF coordination report and Netgear switch master configuration file supplied on a usb flash drive. In the event when systems are updated during service calls during the warranty period, the contractor shall furnish updated system files to the district.

END OF SECTION

SECTION 28 05 00 - GENERAL ELECTRONIC SAFETY SYSTEMS REQUIREMENTS

PART 1 – GENERAL

1.1 WORK INCLUDES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.

B. Furnishing of all required materials, equipment, tools, scaffolding, labor, and transportation necessary for the complete installation of the Electronic Safety Systems as shown on the drawings and as specified herein.

C. Coordinate wireway, raceway, power, and outlet requirements with the builder and the electrical contractor.

D. Cable pathways, conduit, boxes and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.

E. The Electronic Safety Systems Contractor shall provide and install prior to cable installation plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.

F. Supply in a timely manner to the electrical contractor special backboxes for installation as required.

G. It is the intent of the Contract Documents to provide complete installations although every item necessary may not be specifically mentioned or shown.

H. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems, complete in every respect.

I. Provide line-by-line specification review for each Division 28 section annotated to certify compliance or deviation.

1.2 WORK TO BE INCLUDED BY THE ELECTRICAL CONTRACTOR IN BASE CONTRACT PROPOSAL

A. Provide utility services conduit as outlined on drawings as required.

B. All required conduit for accessibility to attic space.

C. Furnishing and installation of all required standard back boxes and conduit.

D. Installation of special back boxes supplied by Division 28 contractor(s).

E. Furnishing and installation of all floor boxes, surface raceways, and other wireways which are detailed or specified under Division 26.

F. Provide equipment-mounting boards as outlined on drawings.

G. Provide equipment grounding system, conductors, and bus bars and as outlined in Division 26.

H. Provide 120-volt power and hook-up to equipment provided in Division 28.

I. Coordination of requirements of Division 28 with the Builder.

1.3 WORK NOT INCLUDED

A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services. Contractors shall not make selection, purchase, or installation of interconnect instruments/equipment to be used on this project.

1.4 RELATED SECTIONS

A. The conditions of the Division 0, Division 1, Division 26 requirements, and the contract requirements that include the General Conditions and the Supplementary Conditions apply to work of this division.

B. Section 26 05 34 - Provisions For Communication, Security & Safety Systems.

1.5 CODES, STANDARDS, AND THEIR ABBREVIATIONS

A. General:
   1. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
   2. In addition to the requirements outlined in other sections of the specifications the following standards are imposed as applicable to the work in each instance:
      a. OSHA Safety and Health Regulations for Construction.
      b. NFPA No. 70 National Electrical Code.
      c. NESC National Electrical Safety Code, ANSI Standard C2.
      d. NEiS National Electrical Installation Standards.
      e. Local Codes and Ordinances.

B. Where local codes or practices exceed or conflict with the NEC, it shall be the Contractor's responsibility to perform the work in accordance with the local code prevailing and local interpretations thereof. Any such additional work shall be performed at no additional cost to the Owner.

C. Materials and components shall be UL listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.

D. The Contractor shall obtain all permits required to commence work. Upon completion of the Work, the Contractor shall obtain and deliver to the Owner's Representative a Certificate of Inspection and Approval from the State Board of Fire Underwriters and other authorities having jurisdiction. The Contractor shall pay required permit fees.

1.6 LIST OF ASSOCIATIONS AND STANDARDS:

ADA:	Americans with Disabilities Act.
ANSI:	American National Standards Institute, 1430 Broadway; New York, NY 10018.
ASTM:	American Society for Testing and Materials, 1916 Race Street; Philadelphia, PA 19103.
BICSI:	(RCDD5 Standards), 8610 Hidden River Parkway, Tampa, FL 33637
CBM:	Certified Ballast Manufacturers Association, 2116 Keith Building; Cleveland, Ohio 44115.
IEEE:	Institute of Electrical and Electronics Engineers, 345 East 47th Street; New York, NY 10017.
ICEA:	Insulated Cable Engineers Association, P.O. Box P, South Yarmouth, MA 02664.
NEC:	National Electrical Code; NFPA No. 70.

NECA: National Electrical Contractors Association, Inc., 7315 Wisconsin Ave.; Washington, DC 20014.
NEMA: National Electrical Manufacturers Association, 155 East 44th Street; New York, NY 10017.
NESC: National Electrical Safety Code, ANSI Standard C2.
NFPA: National Fire Protection Association, 60 Batterymarch Street; Boston, MA 02110.
OSHA: Occupational Safety and Health Administration, US Department of Labor; Washington, DC 20402.
TAS: Texas Accessibility Standards (TAS) Article 9102.
UL: Underwriters Laboratories, Inc., 333 Pfigsten Road; Northbrook, IL 60062.

A. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.

B. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.

C. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.

D. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.

E. Where local codes and ordinances are not in writing or on record but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.7 DEFINITIONS

A. Approval: It is understood that approval must be obtained from the Architect in writing before proceeding with the proposed work. Approval by the Architect of any changes, submitted by the Contractor, will be considered as general only to aid the Contractor in expediting his work.

B. The Builder: The primary contractor engaged to oversee the construction project. They may be technically described as a Construction Manager, General Contractor, Managing Construction Contractor, et cetera.

C. The Contractor: The Contractor engaged to execute the work included a particular section only, although he may be technically described as a Subcontractor to the Builder. If the Contractor, engaged to execute said work, employs Sub-Contractors to perform various portions of the work included under a particular Section, they shall be held responsible for the execution of this work, in full conformity with Contract Document requirements. The Contractor shall cooperate at all times and shall be responsible for the satisfactory cooperation of his Subcontractors with the other Contractors on the job so that all of the various sections and phases of work may be properly coordinated without unnecessary delays or damage.

D. The Electrical Contractor: The Electrical Contractor shall be engaged to execute the work included Division 26 only.

E. PDF file or .pdf: The filename extension associated with “Portable Document Format” files, which are multi-platform computer files in the ISO 32000-1:2008 open standard format developed and licensed by Adobe Systems. These files are a digital electronic representation of text, documents, images, and technical drawings in a font and color-accurate fixed-layout format that is platform and display resolution independent. PDF files can be electronically transmitted, viewed, or printed with various free PDF reader application programs, and may allow markups/comments with various PDF editing application programs.

F. Provide: Defined as requiring both the furnishing and installation of the item or facility indicated, complete in all respects and ready for operation unless otherwise specifically noted.

1.8 SCHEDULE OF VALUES, APPLICATION FOR PAYMENT

A. The Contractor shall in accordance with the General Provisions of the Contract, including General and Supplementary Conditions, and Division 1, complete a Schedule of Values and Applications for Payment. When a portion of this work separately funded, including donations or E-Rate, the contractor shall accommodate this in the Schedule of Values and Applications for Payment. For E-Rate eligible portions of this work, the contractor will be required to participate in the E-Rate program, comply with all E-Rate regulations, and provide billing as needed. The contractor shall coordinate with the Owner to file Form 471 or latter edition and/or other forms as may be required.

1.9 WARRANTY

A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from date of acceptance of the job.

B. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.

C. He shall remedy any defects due thereto, and pay for any damage to other work resulting there from, which shall appear within a period of one year from date of substantial completion.

D. The Owner shall give notice of observed defects with reasonable promptness.

E. This Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.10 SITE VISIT

A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities.

B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.11 SUBMITTALS

A. Submittal procedures shall be per Division 1 - General Requirements.

B. Provide a complete submittal for each section as specified.

C. Submit complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.

D. A submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.

E. Each Product data submittal shall include:
   1. A cover sheet with the name and location of the project, the name, address, and

telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.

2. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
3. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
4. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
6. When the contract requires extended product warranties, submit a sample of warranty language.
7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.

F. Submit shop or coordination drawings, when specified or the required for the scope of work, which include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, and accurate to scale equipment and device layouts prepared using a CAD or BIM engineering drawing program.

G. The Engineer's review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.12 PROJECT RECORD DOCUMENTS

A. The Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building.

B. Upon submitting his request for final payment, he shall turn over to the Architect/Engineer, for subsequent transmittal to the Owner revised plans showing "as installed" work.

C. In addition to the above, the Contractor shall accumulate during the jobs progress the following data in PDF file format (preferred) or paper copies to be turned over to the Architect/Engineer for checking and subsequent delivery to the Owner:

1. All warranties, guarantees, and manufacturer's directions on equipment and material covered by the Contract.
2. PDF file or paper copies of all Shop Drawing prints and CAD or BIM engineering drawing program files.
3. Any software programs, data/programming files, passwords, special interface cables, or keys that may be needed to maintain or access equipment.
4. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
5. Any and all other data and/or plans required during construction.
6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
7. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
   a. Builder and all Contractors.
   b. Major Equipment Suppliers

c. Submit communication systems warranties.

1.13 TRAINING

A. Upon completion of the work and at a time designated by the Architect, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all Electronic Safety Systems equipment and systems.

B. See other sections for time requirements.

1.14 PLANS AND SPECIFICATIONS

A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system.

B. Electrical drawings are generally diagrammatic and show approximate location and extent of work.

C. Install the work complete including minor details necessary to perform the function indicated. Provide Electronic Safety Systems (including all hook-ups) complete in every respect and ready to operate.

D. If clarification is needed, consult the Architect/Engineer.

E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Architect/Engineer for his interpretation.

F. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.15 PRODUCT SUBSTITUTIONS:

A. Descriptions and details, acceptable manufacturers' names listed, and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.

B. Proposed contractors wishing to propose systems which differ in manufacturer, features, functions, or operating characteristics from those outlined in these specifications must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.

C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified and include relevant technical and cost data. This shall include a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.

D. The Engineer will consider all such submittals and the Architect will issue an addendum listing items that the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.

E. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of the alternate system shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure the system will be an acceptable equivalent.

F. The Contractors' proposal represents that the contract proposal price is based solely upon the materials, equipment, and labor described in the Contract Proposal Documents (including addenda, if any) and that he contemplates no substitutions or extras.

G. The manufacturer of the proposed substitute unit shall provide samples for evaluation, when required, at no charge and non-returnable.

H. Requests for substitution are understood to mean that the Contractor:
   1. Has personally investigated the proposed substitution and determined that it is equivalent or superior in all respects to that specified.
   2. Will provide the same guarantee for the substitution that he would for that specified.
   3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
   4. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
      a. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
      b. The specified product is unavailable through no fault of the Contractor.
      c. The manufacturer refuses to warranty the specified products as required.
      d. Subsequent information indicates that the specified product is unable to perform properly or to fit in the designated space.
      e. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.
      f. Revisions to the electrical system caused by substitutions shall be under the supervision of the Engineer, at a standard hourly rate charged by the Engineer. Charges from the Engineer, Architect, and Electrical Contractor shall be paid by the Contractor originating the changes.

1.16 FUTURE USE CABLING

A. When cabling is installed for future use, it shall be identified with a tag of sufficient durability to withstand the environment involved.

B. Locations and Existing Conditions:
   1. Location and condition of any existing equipment or services, when shown, have been obtained from substantially reliable sources, are shown as a general guide only, without guarantees as to accuracy.
   2. The Contractor will examine the site, verify all requirements, service points, and availability of all services required to complete this project. No consideration will be granted for any alleged misunderstanding of the materials and labor to be provided as necessitated by nature of the site including those items that may be fairly implied as essential to the execution and completion of any and all parts of this project.

1.17 PROTECTION OF EQUIPMENT AND MATERIALS

A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.

B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.

C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

1.18 FINAL OBSERVATION

A. It shall be the duty of the Contractor to make a careful observation trip of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Architect/Engineer to make a final observation.

B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.

C. The following and other provision of Division 1 General Conditions will be required at time of final completion:
   1. Final clean up completed.
   2. All systems are fully operational, all material and devices installed.
   3. As built (as installed) drawings and operations manuals.

1.19 PROHIBITED MATERIALS

A. No new asbestos, lead, or materials containing these substances shall be permitted in this project. The Contractor shall consult the Architect concerning these materials if their presence is suspected. All work in or around existing asbestos or lead materials is at the sole risk of the Contractor and his personnel.

1.20 CUTTING AND PATCHING

A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.

B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.

C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.

D. Patching of openings and/or alterations shall be provided by the Electronic Safety Systems Subcontractor or at the Subcontractor's expense in an approved manner.

E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.

F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.

G. All openings in exterior walls shall be sealed watertight.

H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping

materials and methods in accordance with NFPA and local codes.

1.21 MANUFACTURERS' INSTRUCTIONS

A. All equipment and devices shall be installed in accordance with the drawings and specifications, manufacturer's instructions, and applicable codes.

B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product, it shall be the contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.

C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.

1.22 INSTALLATION

A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts are considered a part of this work. In order to effect timely and accurate placing of work and to bring together, in the proper and correct sequence, the work of such trades, including work provided under a Division 1 allowance.

B. The Electronic Safety Contractor shall coordinate installation of the systems with the Builder, Electrical, Mechanical, and Plumbing Contractors to ensure a complete working system for the Owner.

C. Where required for accessibility all conduit and boxes for all Electronic Safety Systems shall be provided by the Electrical contractor as specified, including systems in Division 28, any and all allowances shall be included. Normally low voltage wiring shall run open and supported in accessible attic space. All low voltage wiring in exposed areas such as gyms, stages, shops, and field houses shall be enclosed in conduit. Coordinate with, and verify with Division 26 to provide required conduit and boxes at locations and heights as required.

D. Conduit, innerduct, track, or raceway shall conceal and protect wiring in exposed areas, within walls, through in- accessible areas, floors, chases, under slab, crawlspaces, or underground.

E. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.

F. All work must be performed by workers skilled in their trade. The installation must be complete whether the work is concealed or exposed.

G. Provide stainless screw/bolt hardware wherever stainless devices are used and in potentially wet areas.

H. Coordinate the actual locations of devices and outlets and equipment with building features and mechanical equipment as indicated on architectural, structural, and mechanical drawings. Review with the Architect any proposed changes in outlet or equipment location. Relocation of devices, before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.

1.23 ADDITIONAL MATERIALS: INCLUDE IN THE BASE CONTRACT PROPOSAL

A. All costs to provide 10 additional fire alarm signals including all cable and devices as directed

by the Architect. Conduit and standard back boxes by Division 26 Electrical Contractor.

PART 2 – PRODUCTS

A. Not Applicable

PART 3 – EXECUTION

A. Not Applicable

END OF SECTION

SECTION 28 23 00 – IP SECURITY CAMERA SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide a complete turnkey and tested IP based digital video surveillance system including but not limited to cameras, cabling, integration, and accessibility with Owner's Local/Wide Area Network (LAN/WAN), Internet accessibility thru remote view application software, simultaneous user access capability and all applicable licensing. 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 IP recording software shall be Video Insight.

F. The Contractor performing this scope of work must be a current integrator of solution Video Insight and be able to include information on current support staff to be able to service this client as needed 24x7 for emergency support.

G. Contractor is responsible for coordinating all electrical work required on this project for connection of, any cameras, and conduit. Contractor shall provide a complete turnkey solution to the owner and be responsible for the complete installation of a complete and functional security camera system.

H. All work shall be coordinated through, Facility Improvement Project Manager and GPISD Low Voltage Dept.

I. Maintain existing security camera systems in a manner in which they can provide continuous coverage and protection of school district property during construction,

J. It will be the responsibility of the General Contractor to ensure that the security CCTV System and its components are installed and working at completion of the project. This includes but not limited to the repair/replacement of any component removed or damaged during construction.

K. All systems SHALL be installed in accordance with ALL local, city, state, federal and Authority Having Jurisdiction laws, regulations, codes, standards, and ordinances and approved by the GPISD Facilities Improvement Project Manager, and/or GPISD Low Voltage Dept.

L. All camera installers shall be certified in the installation and programming of IP cameras.

M. The contractor must have a minimum of one (1) year experience in installing at least 32 IP cameras at multiple sites.

N. All bidders should be able to provide a minimum of 3 multi-site installations preferably in school districts in the past one (1) year, if requested by GPISD.

O. All contractors installing I.P. cameras to the I.P. Software. Must certify in writing a 24 hour turn around on trouble calls, if I.P. Video Insight Software, or IP cameras are down.

P. Contractor must have experience/knowledge of Video Insight, client and viewer Software, and programming of Panasonic/i-Pro IP cameras.

Q. Type of I.P Software for I.P. cameras to be installed on all I.P. camera projects will be, Video Insight Software Platforms.

R. All equipment shall be UL Listed and approved for the purpose it is being used.

S. All vendors/contractors/sub-contractors working on CCTV system will submit to GPISD Low Voltage Dept. and GPISD Facility Improvement Project Manager a complete set of plans for approval prior to the beginning of any project. Plans must include, but not limited to, complete equipment list, wiring diagram and POE locations. A Pre-Installation meeting will be held between all parties in order to review submittals and coordinate installation. Additional meetings will be held as needed.

T. All new CCTV I.P. camera installations and upgrades will be a turnkey operation - this includes but is not limited to purchasing, programming and licensing of all software, equipment, focusing of cameras, naming of cameras, administrative views and mapping of the campus within the software.

U. The types of cameras, to be installed will be compatible with and come with free licensing to the Video Insight Software Platform. Preferably Panasonic or i-Pro and be coordinated prior to installation and labeled on shop drawings; Shop drawings must be approved prior to the installation of any equipment for rough in, this will also include all conduit locations, and pathways where applicable. All cameras will use the H.265, unless determine by GPISD low Voltage Dept. otherwise. Locations, Makes, and Models, will be determined by GPISD low Voltage Dept. on a case by case install.

V. There is no minimum camera count, but minimum camera coverage shall include the following locations – doors, stairs, corridors, perimeter of school, bus lane, parent drop off, exterior courtyards, exterior entrances, kitchen entrances and service yard. Locations to be reviewed and approved by GPISD Planning & Construction and GPISD Low Voltage Department during design phase.

W. Locate security monitoring station in general administrative area

X. System will be connected to existing central Video Insight system for district, not located at each campus.

Y. All servers will be purchased by the owner.

1.2 QUALITY ASSURANCE

A. Installer Qualifications:

1. The Video Surveillance System Installer shall be licensed and shall meet all applicable regulations. The Contractor shall be a firm normally employed in the 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.
    f. A Certification from Video Insight, with class completion dates.
    g. A Certification from Fluid Mesh Networks, for use in wireless application weather use on the project or not.

B. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

C. The following is a list of contractors that are approved, meet specifications and have successfully done work for *GPISD.* Low Voltage Dept. Names, Addresses and other information is correct at the time this document was created and subject to changes if approved by GPISD Low Voltage Dept. Facilities

1. Preferred Contractors
    a. Any contractor that meets all other requirements in the specifications must be preapproved by GPISD Planning & Construction no less than 10 days prior to Bid to be considered for the project.

1.3 REGULATORY REQUIREMENTS

A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
1. Local Building Code
2. Local Electrical Code
3. NEC National Electrical Code

B. Other references:
1. TIA/EIA-568-A - Commercial Building Telecommunications Wiring Standard
2. EIA/TIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
3. TIA/EIA-606 - The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
4. TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications
5. TIA/EIA TSB 67 - Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
6. ISO/IEC 11801 - Generic Cabling Standard
7. EN 50173 - Generic Cabling Standards for Customer Premises

C. Governing Codes and Conflicts: 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.

1.4 SUBMITTALS

A. The video surveillance system installer shall furnish all CCTV system submittals in a single consolidated submittal

B. Shop Drawings: Submit the following items, for Owner 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. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer
3. Product Literature: Complete manufacturer's product literature for all electronics, cable, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Architect/Engineer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included.
4. Testing: Proposed Contractor test result forms, a list of instrumentation to be used for systems testing.
5. A complete point-to-point floor plan diagram indicating camera locations part numbers, and all required cabling to connect systems shall be provided for review prior to installation. No work shall start until drawings have been reviewed and approved.

C. All subcontractors shall provide submittals to general contractor for normal distribution to Architects, Engineers and Galena Park ISD project managers. The general contractor shall also distribute to The Galena Park ISD Low Voltage department.

D. Project Completion: As a condition for project acceptance, the Contractor shall submit the following for review and approval:
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. 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)
3. All training sessions with district staff and training media shall be complete.
4. As-built Drawings shall include cable pathways, camera locations with correct labeling on prints and Cameras, with MDF/IDF locations. The as-built drawings shall be prepared using AutoCad. Provide the Owner (GPISD Low voltage Dept.) with electronic versions of the as-built on CDs.

PART 2 -PRODUCTS

2.1 GENERAL REQUIRMENTS

A. Materials shall be as listed no alternate products will be allowed without prior consent of the projects technology consultant. Any items approved as equivalent products shall be published by addendum ten days prior to proposal for Architect/Engineer review.

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. All equipment and materials used shall be standard components, regularly manufactured, regularly utilized in the manufacturer's system.

D. Cable and Connectivity: Refer to GPISD data cabling specifications, and parts list.

E. Cabling will be from the POE switches to the IP camera with no splicing. IP cameras will get their power from the POE switches. Switches to be provided by owner. Refer to GPISD Networking specifications.

F. If camera being used does not have an integrated RJ45 port, then the contractor will terminate cable in data jack in ceiling. The contractor will provide 3 foot patch cord as stated in A.1. Cabling Requirements, Refer to GPISD data specifications and parts list.

G. All cable/wiring will be tested by vendor/contractor/sub-contractor with a meter for continuity, grounds, shorts and opens. Documentation will be provided to GPISD Technology Dept. of test results. Any cable/wiring that does not pass will be replaced in its entirety and retested, No splicing will be allowed.

H. All wiring shall be run in a manner as not to allow wire to be in contact with fluorescent lights or other data generating wiring/devices (data, telephone, video, etc.) steam, hot water or any other attachment that could or will cause damage, decay or interference. All cabling will be appropriately suspended and fastened according to applicable standards.

I. No splices between patch panel and camera are allowed. Each run should have a minimum 5ft service loop at camera and a 10' service loop in closet for a total length not to exceed 325ft Including 20' Patch cable.

J. Conduit
   1. Cable will be protected where deemed necessary to prevent damage. Cable to be in conduit or metal wire mold as required.
   2. Flexible type conduit (SEAL TIGHT) shall be used on exterior weatherproof housing installations. A junction box will be mounted to the building and flexible conduit ran between j-box and camera housing.

3. Conduit/Wire Mold will be dedicated to security CCTV system ONLY. No sharing of conduit/wire mold will be allowed. This includes, but is not limited to, floor, wall and roof penetrations.
4. Conduit must be a minimum of ¾ inch.
5. ALL 120 VAC electrical service or higher needed for system shall be installed/ moved/replaced/removed by the electrical contractor for the project.

2.2 DATA CLOSET (MDF/IDF) TERMINATION HARDWARE

A. Refer to Structured Cabling\Data specifications, and material list.

2.3 INSTALLATION

A. Provide all penetrations and all conduits as necessary for installation of CCTV installation.

B. All exterior penetrations require necessary weatherproofing to avoid moisture penetration.

C. All outdoor cable runs underground shall be rated for underground use.

D. Coordinate the location all power circuits required for the servers and camera power supplies with the project electrical contractor prior to installation.

E. The contractor shall provide a sleeve for cable pathway through any wall. Fire rated walls will require sealing to maintain fire rating.

F. 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.

G. 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.

2.4 IP BASED RECORDING EQUIPMENT

A All NVRs shall be Provided by contractor.
B Newly added cameras shall be integrated to owner's existing VMS platform. Coordinate with owner for additional storage, hardware, and software parameters.

2.5 Cameras

A. Camera Types:
1. Exterior Cameras:
    a. Wall / Pole Mounted: TYPE 1 - Panasonic WV-S2536LNA
2. Interior Fixed Cameras:
    a. All access control doors, Large areas / hallways: TYPE 2 - Panasonic WV-S32302
3. 360 Cameras:
    a. '360' Cameras: TYPE 3 - Panasonic WV-S4556LA

Acceptable Manufacturers:

1. All cameras, unless noted otherwise, shall be IP Network Cameras. Camera types acceptable for use will have free licensing with Video Insight software, and using the H.265 format, preferably Panasonic or i-Pro. Model types determined by GPISD Low Voltage Dept.

2. Tamper resistant with all movable parts enclosed behind a protective cover.

3. Integrated Dome In-Ceiling flush mount.

4. Water resistant.

5. 3-year warranty on all cameras. Refer to Panasonic/i-Pro camera warranty.

6. The contractor shall provide all wall mounts, pole mounts, and associated hardware for exterior cameras.

7. Camera power shall be supplied by POE switches to be provided by owner unless otherwise specified.

8. Pole mount camera infrastructure shall be supplied under section 27 10 00.

E. 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.

F. Contractor will not mount any outside cameras higher than 18ft. or lower than 14ft and will be mounted with heavy duty commercial mounting hardware. Silicon will be used on all exterior cameras as a weather sealant.

G. Contractor will not mount any cameras on an indoor ceiling higher then 12ft; if a ceiling is higher than 12ft then cameras will be mounted on walls.

H. All exterior cameras shall have in line surge suppression.

2.6 CAMERA POWER SUPPLIES

A. Power Supplies for heaters/blower enclosures shall be manufactured by Altronix. There shall be no 16-Channel Power Supplies permitted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cable Pathway: Refer to GPISD Data specifications, and parts list.

B. 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.

C. Wall Penetrations: Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.

D. Provide three sided pre-finished metal hood and seal to wall where conduit penetrates exterior wall.

E. For any required conduit, Install new 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.

F. Do not install wall mounted cameras into metal fascia. Ensure they are mounted into brick, and sealed top and sides (not bottom)

3.2 DOCUMENTATION

A. Labels: The Contractor shall label all Cameras 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.

E. At time of acceptance from contractor to owner, contractor will provide a set of as-builts to owner with all pertinent information.

F. The contractor shall provide metallic name plates for each camera that correspond to as built drawings.

G. The contractor shall provide (2) spreadsheets that contain all installation data for the IP camera system. The spreadsheet must contain the following data.

1. Camera Number
2. Device ID
3. Device Type
4. Model Number
5. Device Location
6. MDF/IDF Location
7. Patch Panel Port
8. Switch Port
9. DLK
10. Mac Address
11. IP Address
12. Subnet
13. Gateway
14. User/Pass
15. Firmware Version
16. Video Encoding Stream Type.

3.3 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. Refer to GPISD Networking specifications.

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 and certified 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.

3.4 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.

B. The contractor shall provide a sign in sheet and all training must be videotaped by the contractor. The contractor shall provide taped training video on (2) DVD discs and sign in sheet to the Spring Brach Technology Department prior to close out. As well as include (2) additional discs for the O&M manuals

3.5 WARRANTY

A Guarantee and warrant all equipment provided for a period of **3 to 5 year** 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.

B. All such warranties shall include all parts.

C. 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.

END OF SECTION

SECTION 28 23 16 – AIPHONE ACCESS CONTROL SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1- GENERAL

1.1 RELATED WORK

A. 26 05 00 – Grounding and Bonding
B. 26 05 29 – Electrical Hangers and Supports
C. 26 05 33 – Raceway and Boxes
D. 28 72 40 – Intrusion Detection and Access Control Systems

1.2 WORK INCLUDED

A. Install a new video access/intercom system at the front entrance and controlled at the main office where noted on the Drawings. System shall be based on AIPHONE equipment. The installation contractor shall be licensed by the State of Texas as a security service contractor. The installation contractor shall be a verifiable Bosch/Radionics and AIPHONE Dealer. Technicians shall be Bosch/Radionics and AIPHONE trained and certified in the various applications necessary.

1.3 CODES AND STANDARDS

The system shall comply with the applicable Codes and Standards as follows:

A. National Electric Code, Article 760.

B. National Fire Alarm Code (NFPA 72).

C. Life Safety Code (NFPA 101)

D. Administrative Council for Terminal Attachments (ACTA):
   1. ANSI/TIA-968-A-2002 Technical Requirements for Connection of Terminal Equipment to the Telephone Network.

E. 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.

F. California State Fire Marshal (CSFM):
   1. Title 19, California Code of Regulations, Building Material Listing Program (BML).

G. 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).

H. 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).

I. International Organization For Standardization (ISO):
   1. 9001 - Quality System.

J. 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

K. Local & State Building Codes

L. Requirements of Local Authorities having Jurisdiction

M. Requirements of American Disabilities Act (Public law 101-336).

N. Texas Accessibility Standards (T.A.S.)

O. State Fire Marshall.

P. Texas Insurance Code.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND INSTALLERS

A. Acceptable Manufacturer: AIPHONE

2.2 SYSTEM MODULES / COMPONENTS

A. AIPHONE Model IX-MV7-W Master Station with desk stand.

B. AIPHONE Model IX-DVF-P Door Station with SBX-IDVF surface mount box if unable to recess. Preferred as recessed mounting. Coordinate for installation and integration of HID sensor.

C. AIPHONE power supply

D. AIPHONE door release relay

E. Any and all accessories necessary for a complete operable system.

F. Provide wiring interface between access system and electric locks and panic hardware provided under other Specification Sections.

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 two conductor, 18 gauge, low capacitance, plenum rated copper wire. Minimum 16 gauge wire for power supply. Color code per CFISD Standards.

C. Door release shall be wired in parallel with card access system door release. Each can release door without interface to the other system.

D. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.

E. 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.

F. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.

G. 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.

H. 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.

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. J-MOD™ 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 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.

3.4 SHOP DRAWINGS / RECORDS / TESTING

A. Contractor shall provide shop drawing noting all equipment to be provided Also provide system wiring diagram showing each device and wiring connection. As built drawings shall be provided after construction with actual locations of devices, cable routing, power supply locations and any other equipment locations. Refer to Division 26 for additional shop drawing requirements.

B. Upon completion of system testing in order to confirm proper operation, contractor shall demonstrate operation of the system to a AISD representative and perform any test or function requested.

END OF SECTION

SECTION 28 31 00 FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of this Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The contractor shall furnish and install a complete distributed microprocessor based 24VDC, electrically supervised, addressable, fire alarm system with voice alarm as specified. The system shall include, but not be limited to, all control equipment, remote transponders, power supplies, alarm initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.

B. The system shall operate as a non-coded, continuous sounding system which will sound alarm devices until manually silenced, as herein specified.

C. The system shall be wired as a Class B supervised system for all circuits.

D. Synchronize all strobes on project.

E. The fire alarm specifications included are to provide a base-line criteria for the project. The contractor shall provide a complete engineered system which meets or exceeds all current codes.

F. Provide two communications paths: digital cellular and IP Internet communicator over GPISD data network.

G. Ensure Fire alarm system monitors all other fire detection systems; all fire suppression systems including fire sprinkler, and dry agent suppression systems, and spray paint booths.

H. Provide wiring to support Field House building and interconnection to CTE building MDF A114 FACP

1.2 CODES AND STANDARDS

A. National Fire Protection Association Standards, use latest published editions unless a previous version is adopted and in effect by the local AHJ at time of building permit application. The system shall comply with the applicable Codes and Standards as follows:

A. National Electrical Code - Article 760.
B. National Fire Protection Association
Standards: NFPA 70 NEC
NFPA 72 National Fire Alarm Code
(2013) NFPA 90A Air Conditioning
NFPA 101 Life Safety
Code UL 1971 Visual
Devices ANSI 117.1
Visual Devices
C. Local & State Building Codes (Including all adopted amendments)
D. Texas Accessibility Standards (TAS)

E. American's with Disabilities Act (ADA)
F. Requirements of Local Authorities having Jurisdiction
G. Underwriters Laboratory Requirements and Listings for use in Fire Protective Signaling Systems as follows:

UL 864 Control Panels (9th Edition) UL 268 Smoke Detectors - Systems UL 268A Duct Smoke Detectors
UL 521 Heat Detectors
UL 228 Door Holder-Closers
UL 464 Audible Signaling Appliances UL 1971 Visual Signaling Appliances UL 38 Manual Alarm Stations

1.3 CONTRACTOR QUALIFICATIONS

A. The installing contractor shall be the authorized representative of the fire alarm manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the fire alarm manufacturer's product for at least two years.

B. The installing contractor shall be licensed by the State Fire Marshal to sell, install, and service fire alarm systems as required by the Texas Insurance Code.

C. The installing contractor shall have on his staff an installation technician licensed by the State Fire Marshal's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.

D. The installing contractor or equipment supplier shall have on staff a minimum of two (2) certified NICET Level III state licensed fire alarm planning superintendents under whose supervision system design shall take place. In lieu of an alarm planning superintendent, the contractor may provide design supervision by a registered professional engineer.

E. The installing contractor shall provide 24-hour, 365 days per year emergency service with factory trained, state licensed service technicians.

F. The installing contractor shall have been actively engaged in the business of planning, selling, installing, and servicing fire alarm systems in the surrounding area for at least ten (10) years

1.4 ACCEPTABLE MANUFACTURERS

A. Notifier NFS2-3030 series and applicable annunciator panels.

B. SilentKnight 6820EVS series as last-resort where Notifier is unavailable in acceptable timeframe of construction completion.

C. 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.

D. 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 GPISD.

1.5 SUBMITTALS

A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:

   A. Control panel configuration including wiring and interconnection schematics.
   B. Complete point to point wiring diagram showing terminal connections to all system devices.
   C. Riser wiring diagram and associated zoning/addressing configurations with associated conduit sizes.
   D. Complete floor plan drawings locating all devices associated with the fire alarm system. Floor plan drawings shall include conduit and wiring routing complete with conduit sizing and number of conductors by type. Floor plans shall be on AutoCAD 2017 or later.
   E. Factory data sheets on each piece of equipment to be used and so marked as to model, dimensions, size, voltage, and configuration.
   F. Detailed system description in this specification format describing system functions and operation. All specification variations and deviations shall be clearly noted and marked.
   G. Complete Bill of Material for reference.
   H. Programming matrix defining all input/output functions and zoning.
   I. Power supply and battery calculations.
   J. Written certification from the manufacturer stating that the distributor is authorized to sell, service and install the proposed fire alarm system.

B. All submittal data will be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.

C. The detailed planning and design of the fire alarm system shall be provided by the fire alarm contractor’s planning superintendent or their professional engineer and as required by the State Fire Marshal and the TSBPE. Only basic equipment devices may be shown on the contract drawings indicating special intent or requirements, specific locations of equipment or devices for building aesthetic reasons, other performance requirements or those that exceed the minimum code requirements. It is the contractor’s responsibility to submit for permit approval the system design configuration and planning layout showing all devices, wiring, conduit, and locations along with other required information as required to provide a complete operational system as specified in the contract documents.

1.6 COORDINATION

A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades including, but, not exclusive of: electrical contractor, sprinkler contractor, and HVAC/controls contractor and intercom system. Adequate coordination shall be provided to ensure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.

1.7 ADDITIONS AND RENOVATIONS

A. Ensure existing building fire alarm system is protected from damage during renovations and additions.

B. Maintain existing fire alarm system in full working condition in existing building during building addition projects or provide a fire watch acceptable to the local AHJ and GPISD.

C. Bag or cover all alarm initiating devices during renovations in areas that are under construction. Remove covers at the end of each day.

D. Maintain access to all existing equipment.

E. Prior to construction, a system test shall be required of the contractor to demonstrate the current state of the system. Any non-functioning item at this time shall be noted by the contractor and addressed by GPISD maintenance. Either the deficiency will be corrected by GPISD maintenance, or the remedy shall to be included in the contract documents to be repaired or corrected by the contractor unless otherwise directed by GPISD. A written report of the outcome of the initial test shall be submitted by the contractor to the Architect and reviewed by GPISD. If system is proven to be 100% functional, or the contractor fails to submit the report in a timely manner for GPISD review prior to construction, the contractor is responsible for any repair necessary to return it to a fully operational system acceptable to the AHJ and GPISD at no additional cost to GPISD.

F. When the fire alarm system is fully tested and 100-percent fully operational, a demonstration is required by the contractor to demonstrate to the Architect and GPISD that the system is fully operational as a requirement for project substantial completion. This demonstration for GPISD is not intended for contractor's testing and commissioning of the system, it is for demonstration of a fully operational system. If excessive failures or deficiencies occur, the Architect may cancel the demonstration and reschedule at a time convenient to GPISD.

PART 2 PRODUCT

2.1 MANUFACTURERS

A. Main Fire Alarm Control Panel (FACP): Notifier

B. Fire Alarm System Annunciator: Notifier

C. Remote Power Supply (RPS): Notifier

D. Area Smoke Detectors and Heat Detectors: Notifier

E. CO Smoke Detector: Honeywell

F. Addressable Manual Pull Stations: Notifier

G. Relay and Monitor Modules: Notifier

H. Strobes, Combination Speaker and Strobes, and Weatherproof Speaker: System Sensor

I. Single Ended Reflected Type Beam Smoke Sensor with RTS: Honeywell

2.2 MATERIALS

A. Main FACP or network node shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system-controlled devices.

B. System Devices and components shall be provided as specified on the fire alarm equipment legend and as shown on associated technology drawing.

2.3 COMPONENTS

A. FACP shall be a Notifier NFS2-3030 – Existing in CTE MDF 1807
1. The NFS2-3030 is part of the ONYX® Series of products from NOTIFIER. The NFS2-3030 is ideal for virtually any application because it features a modular design that is configured per project requirements. With one to ten Signaling Line Circuits (SLCs), the NFS2-3030 supports up to 3,180 intelligent addressable devices.
2. Complies with UL 2572 Mass Notification Systems (NFS2-3030 version 20 or higher).
3. One to ten isolated intelligent Signaling Line Circuits (SLC) Style 4, 6 or 7.
4. Up to 159 detectors and 159 modules per SLC; 318 devices per loop/3,180 per FACP or network node. Detectors can be any mix of ion, photo, thermal, or multi-sensor; wireless detectors are available for use with the FWSG.
5. Modules include addressable pull stations, normally open contact devices, two-wire smoke detectors, notification, or relay; wireless modules are available for use with the FWSG.
6. Large 16 line, 640 character LCD backlit display or use.
7. High-speed network for up to 200 nodes.
8. Standard network for up to 103 nodes. Up to 54 nodes when DVC-EM is used in network paging.
9. Built-in Alarm, Trouble, Security, and Supervisory relays.
10. With built-in Degraded Mode operation, the system is capable of general alarm if a fire alarm condition is present even if the central processing unit (CPU) fails.
11. Weekly Occupancy Schedules allow changing sensitivity by time of day and day of week.
12. EIA-485 annunciators, including custom graphics.
13. Alarm Verification selection per point, with automatic counter.
14. Multiple central station communication options:
– Standard UDACT
– Internet
– Internet/GSM
15. Field-programmable on panel or on PC, with VeriFire Tools program, also check, compare.
16. Supports SCS Series smoke control system in both HVAC and FSCS modes.
17. FM6320 approved Gas Detection System with FMM-4-20 module and any FM listed gas detector.

B. Fire Alarm System Annunciator (RA-1000)
1. The RA-1000 is a remote annunciator used to operate and program IFP-series fire alarm control panels (FACPs).
2. The RA-1000's keypad and display match the built-in annunciator of the GWF-7075 fire alarm control panel.
3. The remote annunciator connects to the fire alarm control panel via the RS-485 system bus. When the system is in normal operation and has AC power, the Power LED is lit and all other LEDs are off. When any of the following conditions occur, the following LEDs turn on:
- Alarm
- Supervisory
- Troubles
- System silenced
- AC power losses

C. Remote Power Supply (FAPS)
1. The FCPS-24S8 is a Notification Appliance Circuit (NAC) extender panel designed to extend the power capabilities of existing NACs and provide power for other ancillary

devices. The FCPS-24S8 will connect to any brand of UL-Listed Fire Alarm Control Panel (FACP) to provide Notification Appliance Circuit expansion.

2. The FCPS-24S8 provides filtered and electronically regulated power distributed to four NACs. Each NAC is rated at 3.0 A maximum, auxiliary power rated 1.5 A, with a total output capacity of 8.0 A. The outputs may be configured as: four Class B (Style W, X, Y); or two Class A (Style Z); or two Class B and one Class A; or four Class A (Style Z) with the optional Class A adaptor installed. The FCPS-24S8 includes an internal battery charger.
3. The FCPS-24S8 provides independent output circuit supervision; so, in the event of a NAC fault, the FF8 can notify the FACP. The FCPS-24S8 has field-selectable, built-in strobe and horn sync protocols that support Faraday, Gentex, System Sensor, Amseco, and Wheelock devices; and a pass-through feature that passes a pre-generated sync protocol from another synchronization source. Independent horn silencing via sync protocol allows synchronized horns and strobes to operate on a single circuit. For enhanced notification appliance circuit survivability, the FCPS-24S8 can utilize its dual-activation inputs for redundant trip operation.

D. Intelligent Photoelectric Smoke Detector
1. The Notifier FSP-951 (photo) is an analog, addressable, low-profile smoke detector designed for the entire line of intelligent systems from NOTIFIER.
2. The FSP-951T photo model includes a built-in thermal (heat) detection device. If either condition (smoke or heat) is detected, the device will alarm.
3. The addressability of the FSP-951 enables the control panel to provide firefighters with a pinpoint description of where the fire is located. The FSP-951 is also analog devices. The control panel is capable of not only knowing the detector's location but exactly how much smoke is in the chamber of the detector. The detector may be set for different sensitivity settings appropriate to the environment of its location.
4. Listed to UL 268.
5. Built-in functional test switch activated by external mag-net.
6. Visible bicolor LEDs blink green every time the detector is addressed, and illuminate steady red on alarm.
7. Dual LED design provides 360° viewing angle.
8. Rotary 01 to 159 address switches (01 to 99 on traditional systems).

E. Intelligent Thermal Detectors
1. Notifier FST-851(A) Series intelligent plug-in thermal detectors with integral communication has features that surpass conventional detectors.
2. Point ID capability allows each detector's address to be set with rotary, decimal address switches, pro-viding exact detector locations.
3. FST-851(A) Series thermal detectors use an innovative thermistor sensing circuit to pro-duce 135°F/57°C fixed-temperature (FST-851/A) and rate-of-rise thermal detection (FST-851R/A) in a low-profile package. FST-851H(A) provides fixed high-temperature detection at 190°F/88°C. These thermal detectors provide effective, intelligent property protection in a variety of applications. FST-851(A) Series detectors are compatible with Notifier Onyx and CLIP series Fire Alarm Control Panels (FACPs).

F. CO Detector
1. The Honeywell MCS-COF3 is plug-in addressable devices that provide both fire and carbon monoxide (CO) detection.
2. The detector combines four separate sensing elements to sense multiple components of a fire: smoke, CO, light/flame, and heat. This approach enables enhanced sensitivity to real fire with heightened immunity to nuisance particulates.
3. Multiple sensors and communication can greatly reduce nuisance alarms compared to single sensing methods. Sophisticated algorithms maximize the advantages of all four sensor types creating our best detection strategy offering heightened immunity to nuisance particulate and enhanced sensitivity to real fire.

4. UL models meet UL 268 7th edition and UL 521 listing requirements for fire detection and UL 2075 standard for system-connected life safety carbon monoxide detection.
5. B200S series intelligent sounder bases are recommended for use with MCS-COF3 and MCS-COF3-IV. These bases can generate either a Temp 3 pattern for fire or a Temp 4 pattern for CO alarm indication. The B200S series bases recognize the System Sensor synchronization protocol for use as a component of the general evacuation signal — along with other System Sensor Audible/Visible devices — when connected to a power supply or Fire Alarm Control Panel (FACP) output capable of generating the System Sensor synchronization pulses.
6. Operates in Velociti® SLC protocol

G. Addressable Manual Fire Alarm Box (manual station)
1. The NOTIFIER NBG-12 Series is a cost-effective, feature-packed series of non-coded manual fire alarm pull stations. It was designed to meet multiple applications with the installer and end-user in mind. The NBG-12 Series features a variety of model including single- and dual-action versions.
2. The NBG-12 Series provides an alarm initiating input signal to conventional fire alarm control panels (FACPs) such as the SFP Series, and to XP Transponders. Its innovative design, durable construction, and multiple mounting options make the NBG-12 Series simple to install, maintain, and operate.
3. Meets ADA 5 lb. maximum pull-force. Meets UL 38, Standard for Manually Actuated Signaling Boxes. Easily operated (single- or dual-action, model dependent), yet designed to prevent false alarms when bumped, shaken, or jarred.
4. Can be surface-mounted (with SB-10 or SB-I/O) or semi-flush mounted. Semi-flush mount to a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box. Backplate is large enough to overlap a single-gang backbox cutout by 1/2" (1.27 cm).
5. Manual Fire Alarm Stations shall be non-code, with a key- or hex-operated reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key or hex. An operated station shall automatically condition itself so as to be visually detected as activated. Manual stations shall be constructed of red colored LEXAN (or polycarbonate equivalent) with clearly visible operating instructions provided on the cover.

H. Addressable Dry Contact Monitor Module
1. The Notifier FMM-1 Monitor Module is intended for use in intelligent, two-wire systems, where the individual address of each module is selected using the built-in rotary switches. It provides either a 2-wire or 4-wire fault tolerant initiating device circuit (IDC) for normally open contact fire alarm and supervisory devices, or either normally open or normally
closed security devices. The module has a panel con-trolled LED indicator. The FMM-1 can be used to replace an MMX-1 module in existing systems.
2. The FMM-1 mounts directly to 4″ square electrical boxes. The box must have a minimum depth of 2⅛″.

I. Addressable Relay Module
1. The Notifier FRM-1 Relay Control Module is intended for use in intelligent, two-wire systems where the individual address of each module is selected using the built-in rotary switches. It allows a compatible control panel to switch discrete contacts by code command. The relay contains two isolated sets of Form-C contacts, which operate as a DPDT switch and are rated in accordance with the table in the manual. Circuit connections to the relay contacts are not supervised by the module. The module also has a panel-controlled LED indicator. This module can be used to replace a CMX-2 module that has been configured for Form-C operation.
2. The FRM-1 mounts directly to 4″ square electrical boxes. The box must have a minimum depth of 2 1/8”.

J. Ceiling Mounted Strobe
1. The LED notification appliances shall be System Sensor SCR Visual Strobe appliances for ceiling-mount applications with a low-profile design or approved equals. The Strobes shall be listed for UL Standard 1971 (Emergency Devices for the Hearing-Impaired) for Indoor Fire Protection Service.
2. The Series shall be Restriction of Hazardous Substances (RoHS) compliant and contain no mercury or other hazardous substances.
3. All Series shall meet the requirements of FCC Part 15 and ICES-003.
4. All inputs shall be compatible with standard reverse polarity supervision of circuit wiring by a Fire Alarm Control Panel (FACP) with the ability to operate from 16 to 33 VDC.
5. The Strobe appliances shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range and shall incorporate a Light Emitting Diode (LED) as the light source with a rugged Lexan® lens. The appliances shall be of low current design. The LED strobe flash duration shall be 20ms. Where multi-candela appliances are specified, the strobe intensity shall have 4 field selectable settings at 15, 30, 75, 95 candela for ceiling-mount applications. The selector switch for selecting the candela shall be tamper resistant. Appliances with candela settings shall show the candela selection in a visible location at all times when installed.
6. The Strobe mounting options shall include Ceiling backboxes, 4” square, 1 1/2 or 2 1/8”deep and 4” Octagonal, 1 ½” or 2 1/8”deep. Two wire appliance wiring shall be capable of directly connecting to the mounting base. Removal of an appliance shall result in a supervision fault condition by the Fire Alarm Control Panel (FACP).
7. All notification appliances shall be backwards compatible.
8. The LSTC3 ceiling models shall have a low profile measuring 6.26” Diameter with 1.5”D.
9. When synchronization is required, the appliance shall be compatible with Sync Modules, PS Power Supplies, SAFEPATH products or other manufacturer’s panels with built-in Wheelock® Patented Sync Protocol. The strobes shall not drift out of synchronization at any time during operation. If the sync protocol fails to operate, the strobe shall revert to a non-synchronized flash-rate and still maintain (1) flash per second over its Regulated Voltage Range. The appliance shall also be designed so that the audible signal may be silenced while maintaining strobe activation when used with patented sync protocol.

K. Wall Mounted Strobe
1. The notification appliances shall be System Sensor SRL Visual Strobe appliances for wall-mount applications with a low-profile design or approved equals. The Strobes shall be listed for UL Standard 1971 (Emergency Devices for the Hearing-Impaired) for Indoor Fire Protection Service.
2. All inputs shall be compatible with standard reverse polarity supervision of circuit wiring by a Fire Alarm Control Panel (FACP) with the ability to operate from 16 to 33 VDC.
3. The Strobe appliances shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range and shall incorporate a Light Emitting Diode (LED) as the light source with a rugged Lexan® lens. The appliances shall be of low current design. The LED strobe flash duration shall be 20 ms. Where multi-candela appliances are specified, the strobe intensity shall have 4 field selectable settings at 15, 30, 75, 110, candela for wall-mount applications. The selector switch for selecting the candela shall be tamper resistant. Appliances with candela settings shall show the candela selection in a visible location at all times when installed.
4. The module shall be a System Sensor Sync.Circuit model MDL3 listed to UL 464 and shall be approved for fre protective service. The module shall synchronize SpectrAlert strobes at 1 Hz and horns at temporal three. Also, while operating the strobes, the module shall silence the horns on horn strobe models over a single pair of wires. The module shall mount to a 411⁄16 × 411⁄16 × 21⁄8-inch back box.

5. The module shall also control two Style Y (class B) circuits or one Style Z (class A) circuit. The module shall synchronize multiple zones. Daisy chaining two or more synchronization modules together will synchronize all the zones they control. The module shall not operate on a coded power supply. All notification appliances shall be backwards compatible.
6. The wall models shall have a low profile measuring 4.53”H x 2.76”W x 1.27”D.
7. When synchronization is required, the appliance shall be compatible with Sync Modules, PS Power Supplies, SAFEPATH products or other manufacturer’s panels with built-in Sync Protocol. The strobes shall not drift out of synchronization at any time during operation. If the sync protocol fails to operate, the strobe shall revert to a non-synchronized flash-rate and still maintain (1) flash per second over its Regulated Voltage Range. The appliance shall also be designed so that the audible signal may be silenced while maintaining strobe activation when used with sync protocol.

L. Combination Speaker Strobes
1. The System Sensor SPSRL Wall mounted Speaker Strobes are designed for high efficiency sound output for indoor applications. The product line features intelligible communications with crisp, clear voice messages and tone signaling, ideal for mass notification and voice evacuation.
2. Providing a sleek aesthetic appearance, the wall and ceiling appliances feature dual voltage (25/70 VRMS) capability and field-selectable taps from 1/8 to 2 watts. For faster and easier installation, the low-profile design incorporates a speaker mounting plate, and each model has a built-in level adjustment feature and snap-on cover with no visible mounting screws.
3. For visible signaling to meet the hearing impaired, the E Speaker Strobe models incorporate the low current draw of the Strobes.
4. Ceiling mount models are available in multi-candela ceiling strobe with field selectable intensities of 15/30/75/95/110/115cd or the high intensity strobe with field selectable 135/150/177/185cd.
5. The strobe portion of all Speaker Strobes may be synchronized when used in conjunction with the Sync Modules, Power Supplies or other manufacturers panels incorporating the Wheelock Patented Sync Protocol.
   Synchronized strobes offer an easy way to comply with ADA recommendations concerning photosensitive epilepsy.
6. Speaker Strobes are UL Listed for indoor use under Standard 1971 (Signaling Devices for the Hearing-Impaired) and Standard 1480 (Speaker Appliances). All inputs employ IN/OUT wiring terminals for fast installation using #12 to #18 AWG wiring.
7. The speakers shall be UL Listed under UL 1480 for Fire Protective Service and speakers equipped with strobes shall be listed under UL 1971 for Emergency Devices for the Hearing-Impaired. In addition, the strobes shall be certified to meet the requirements of FCC Part 15, Class A.
8. All models shall have listed sound output of up to 87 dB at 10 feet and a listed frequency response of 400 to 4000 Hz. The speaker shall also incorporate a sealed back construction.
9. The speaker and speaker strobe appliances shall be designed for indoor flush mounting. The speaker and speaker strobe shall incorporate a speaker mounting plate with a snap-on grille cover with no visible screws for a level, aesthetic finish and shall mount to standard electrical hardware. The finish of the Speakers and Speaker Strobes shall be red. All speaker and speaker strobe appliances shall be backward compatible.
10. When synchronization is required, the strobe portion of the appliance shall be compatible with sync modules or the Power Supplies with built-in Patented Sync Protocol. The strobes shall not drift out of synchronization at
    any time during operation. If the sync module or Power Supply fails to operate, (i.e., contacts remain closed), the strobe shall revert to a non-synchronized flash rate.

M. Weatherproof Speaker
1. System Sensor SPRK Weatherproof notification appliances shall be UL listed for outdoor use. The appliances shall be available for optional wall mounting or ceiling mounting to weatherproof backboxes using either exposed conduit, concealed conduit, or semi-flush mounting to a recessed electrical box in walls or ceilings using Wheelock mounting accessories.
2. Wall-mount outdoor speakers can be used indoors or outdoors in wet or dry applications, and can provide reliable operation from −40°F to 151°F. These speakers provide a broad frequency response range, low harmonic distortion and maintain a high sound pressure level at all tap settings to provide accurate and intelligible broadcast of evacuation messages.
3. Field-selectable settings, including candela, speaker voltage and power settings, and automatic selection of 12- or 24-volt operation enable installers to easily adapt devices to meet requirements.
4. Weatherproof audibles shall be System sensor models or approved equals. The speaker devices shall be able to produce a continuous output or a temporal code-3 output that can be synchronized.
5. Speaker shall be listed to Underwriters Laboratories Standard S4048 for outdoor fire protective signaling systems. Speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature from –40°F to 150.8°F. Speaker shall have power taps and wattage settings that are selected by rotary switches. The speaker must be installed with its weatherproof back box in order to remain outdoor approved per UL listing S4048. The speaker shall be suitable for use in air handling spaces and wet environments.

N. Single Ended Reflected Type Beam Smoke Sensor with Remote Test Switch:
1. The Honeywell OSI-RI-SK intelligent addressable reflector-type linear optical beam smoke detector is uniquely suited for protecting large open areas with high ceilings. The OSI-RI-SK detector is a combined transmitter/receiver and is compatible with Silent Knight Addressable Fire Alarm Control Panels.
2. The receiver imager automatically tracks the reflector in case of building movement or support structure movement. This allows the OSI-RI-SK to be highly resistant to movement, eliminating the number one cause of false alarms and/or faults with traditional beam detectors. Optical filtering, high-speed image acquisition and intelligent software algorithms provide the system with highly improved resistance to false alarms from sunlight, reflected sunlight or any other very bright light sources. Advanced smoke imaging techniques allow the detector to avoid false alarms from partial and sudden blockage from foreign object intrusion.
3. Remote test station capable for electronic simulated smoke test from ground level.
4. 50° horizontal and 20° vertical beam adjustment.

O. Battery
1. The battery shall have sufficient capacity to power the fire alarm system for no less than twenty-four hours plus 15 minutes of alarm upon a normal AC power failure.
2. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.
3. If necessary, to meet standby requirements, external battery and charger systems may be used.

PART 3 EXECUTION

3.1 COORDINATION

A. Refer to the electrical and mechanical drawings and specifications to determine quantities

and location of devices and required scope of work and coordinate work with mechanical and electrical installers. Provide function described under mechanical section Sequence of Control, for fire and/or emergency conditions. Submit proposed interconnection to elevator supplier. Submit conduit and pathing requirements to electrical installer. For self-contained door release, coordinate with door supplier.

3.2 GENERAL

A. Comply with all applicable paragraphs in Section 26 05 00: Common Work Results for Electrical, apply as though repeated herein

B. Install system(s) in accordance with manufacturer's instructions.

C. Include services of certified technicians to supervise installation, provide adjustments, provide final connections, system testing and system training to Owner Representative

3.3 INSTALLATION

A. Installation shall be in accordance with the CEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports, and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.4 GROUNDING

A. All equipment to be grounded by means of green ground wire to "U" contact of duplex receptacles and bonded to ground provided under 26 05 26: Grounding and Bonding of Electrical Systems.

3.5 INSPECTION

A. Systems to meet all the requirements of the IOR and AHJ and shall be approved thereby before installation and prior to final acceptance.

3.6 LOCATION

A. Before installation, verify exact location of control equipment and outlets. The Owner reserves the right to relocate system components within a radius of 10' at no increase in cost before rough-in work is started for the respective component.

3.7 WIRING

A. Furnish all conductors, equipment, terminal strips, etc., and labor to install a complete and

operable system. All cable conductors shall be color coded and numbered for identification at all terminals. Green shall be for grounding conductor only. Use red insulation and or red jacketing on all fire alarm cable.

3.8 TESTING

A. After all equipment specified herein for each system has been installed and is in operating condition, conduct performance tests to determine if the installation and components comply with these specifications. Furnish competent personnel, all test material and approved test instruments and conduct the tests under supervision of factory personnel, in the presence of the Engineer, the building and fire inspecting agencies:

1. The contractor's job foreman, in the presence of a representative of the manufacturer, a representative of the owner, and the fire department shall operate every installed device to verify proper operation and correct annunciation at the control panel.
2. At least on half of all tests shall be performed on battery standby power.
3. Where application of heat would destroy any detector, it may be manually activated.
4. The signaling line circuits and notification appliance circuits shall be opened in at least two (2) locations to verify the presence of supervision.
5. When the testing has been completed to the satisfaction of the contractor representative IOR, representatives of the manufacturer and owner, a notarized letter co-signed by each attesting to the satisfactory completion of said testing shall be forwarded to the owner and the authority having jurisdiction.
6. The contractor shall leave the fire alarm system in proper working order, and, without additional expense to the owner, shall replace any defective materials or equipment provided by him under this contract within two years from the date of final acceptance by the awarding authority.
7. The local responding fire department must be notified prior to the final test in accordance with local requirements and when requested, participate in system testing and evaluation.

3.9 REPORT

A. Prepare written report of final test results, signed by witnessing parties. Submit to the Engineer in triplicate for final approval.

END OF SECTION 28 31 00

SECTION 28 72 40 - INTRUSION DECTECTION SYSTEM / ACCESS CONTROL SYSTEM

GENERAL

1.1 SCOPE OF WORK

A. The concept of the SCOPE OF WORK is to provide to Galena Park Independent School District. (Henceforth referred to as GPISD) the highest quality product/service and:

B. Coordinate ALL work through GPISD Police Department and other relevant GPISD staff.

C. Unless otherwise noted prior to start of the project, all systems will be considered to be fully functional. It is the responsibility of the GENERAL CONTRACTOR to note any deficiencies in the system prior to starting any project and submit this prior to start of work. An AUTHORIZED security system contractor will be required for this purpose. It is the responsibility of the GENERAL CONTRACTOR to provide GPISD Police Department and other relevant GPISD staff a copy of the existing system status prior to the start of any construction. This report shall be included in the security contractor's submittal package.

D. It will be the responsibility of the general contractor on a daily basis, to repair damage to the existing security alarm/access control systems in a manner in which they can provide continuous coverage and protection of school district property during construction. The general contractor is REQUIRED to make repairs within forty-eight (48) hours notice of service request. An AUTHORIZED security system contractor will be required for this purpose (See section Approved Contractors).

E. An AUTHORIZED security system contractor will be required for the purpose of working

F. on ANY portion of the security system. Other trades (Electrical Contractors, etc.) SHALL NOT work on any portion of the security system except as otherwise noted in this document. And

G. GPISD Police Department must be notified daily of any changes in the status of the system. An AUTHORIZED security system contractor may move, remove or disable existing sensors/wiring/systems during construction as needed. With approval, secure and retain all parts in whole where possible and return to owner, or Install new/replacement/additional system(s)/part(s) where appropriate.

H. IT WILL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO SEE THAT THE SECURITY ALARM SYSTEM, AND/OR ACCESS CONTROL SYSTEM AND ITS COMPONENTS ARE INSTALLED AND WORKING AT COMPLETION OF THE PROJECT. THIS INCLUDES BUT NOT LIMITED TO THE REPAIR/REPLACEMENT OF ANY COMPONENT REMOVED, LOST, STOLEN OR DAMAGED DURING CONSTRUCTION.

I. Job specifications/documents/books SHALL include:

J. Work shall be done in accordance with the latest revision of the GPISD Specifications.

K. All systems SHALL be installed in accordance with ALL local, city, state, federal and Authority Having Jurisdiction laws, regulations, codes, standards and ordinances. All equipment shall be installed and tested in accordance with MANUFACTURES specifications and installation instructions. Additional requirements may be found in other sections of this document. All equipment will be UNDERWRITERS LABORATORIES Inc. approved for the purpose it is being used.

L. Security Contractor(s) & Sub-Contractors:

M. All RADIONICS/BOSCH equipment and SECURITY DEVICES (Sensors, Door Contacts, Power Supplies, Panels, etc.) will ONLY be installed by an authorized security system contractor (See section Approved Contractors).

N. An "authorized" security contractor WILL be the PRIMARY security contractor for the project. The primary security contractor WILL be an AUTHORIZED RADIONICS/BOSCH DEALER utilizing factory trained personnel/technicians (See section 23) – NO EXCEPTIONS.

O. Use of sub-contractor(s) by the PRIMARY Security Contractor WILL require on-site

supervision, at all times, of the sub-contractor(s) by the primary contractor's factory trained personnel/technician(s) - NO EXCEPTIONS.

P. A copy of the Radionics/Bosch Dealer Certificate and Number or letter from RADIONICS/BOSCH verifying dealership currently in good standings, WILL BE REQUIRED – NO EXCEPTIONS.

Q. A copy of dealer's personnel/technician(s) certified RADIONICS/BOSCH training WILL BE REQUIRED – NO EXCEPTIONS.

R. ALL personnel doing work on Section 1, MUST have current training certificates for the RADIONICS/BOSCH equipment being installed (B9512G Alarm Communicator, etc.).

S. SECTION 1 EXCEPTIONS: Cable/wire installation, Hardware such as poles, conduit, pull boxes, high voltage electrical (90vac +) etc. may be installed by others.

T. Alarm system control panel will consist of RADIONICS/BOSCH brand, model series B9512G. This will include upgrade to and/or replacement of existing panel(s) at the project facility. This may also include upgrading all or part of the existing system (POPIT's, Keypads, etc.) to be compatible with the model B9512G panel.

1.2 NO EXCEPTIONS

A. Panels will be equipped with, but not limited to, the following features: Dual Batteries of not less than 12VDC, 7Ah. each. B430 module. Transformer (As required by panel model number) One (1) telephone line cord. Command Center (Keypad). One (1) network drop. Quantity to be determined by project requirements.

B. Enclosure (Cabinet) Grey in color. Other colors as approved by Galena Park I.S.D Police Department. Red will not be allowed. Two (2) POPEX Modules. POPIT module of the latest version available at the time of installation. Quantity as required by project. Non-tampered version ONLY. ACCESS CONTROL Module(s) and equipment. If required by project. See Section 15. Network Interface Card

C. POPIT data loops/circuits will be installed and tested in accordance with RADIONICS POINT IDENTIFICATION SYSTEM VALIDATION PROCESS REV. 00.17 AUGUST 1995 or later. All POPITS will be mounted in a protective box with cover and in such a manner as to allow for service/replacement from a standard six (6) foot step ladder.

D. Popit must be in a 1900 box located next to the device. If device is in a classroom place the 1900 box in the hallway if you can service it from a 6ft. ladder.

E. All vendors/contractors/sub-contractors working on security alarm system will submit to GPISD Planning & Construction and Police Department Alarm Division complete plans for approval PRIOR to the beginning of any project.

F. Submittals must include, but not limited to, complete equipment list, wiring diagram, sensor type and location, power supply, panel and keypad location(s) POPIT location, address and description, Status of existing security alarm system. Equipment cut sheets, including wire specifications voltage & battery calculations Contractor qualifications, including but not limited to dealer certificates, personnel & technician certificates, sub- contractor information & qualifications etc., contact name and numbers of all parties including sub-contractors. warranty & service information

G. A PRE-INSTALLATION meeting WILL BE held between all parties in order to review submittals and coordinate installation. Additional meetings will be held as needed.

H. Vendor/contractor will supply GPISD Planning & Construction and Police Department Alarm Division a complete set of "AS BUILT" drawings within ten (10) days from job completion. The drawings must accurately include, but not limited to, actual cable routing, sensors type and location,

I. POPIT locations, power supply locations including electrical panel and breaker number, Keypad (s) and panel locations, correct room numbers and any other information deemed necessary. Drawings will be submitted as electronic drawings (CAD). DRAWINGS WILL BE REQUIRED PRIOR TO ACCEPTANCE OF JOB.

J. Final inspection of "AS BUILT" job will be performed by Galena Park I.S.D. Police Department Alarm Division prior to acceptance of job. Any/All corrections will be completed prior to acceptance of the system.

K. Contractor will maintain sufficient spare parts in order to facilitate warranty repairs in a timely manner.

L. General Contractor will provide warranty and service for all parts and labor within forty-eight (48) hours notice for a period of one (1) year from the date of ACCEPTANCE by GPISD Planning & Construction and Police Department Alarm Division. The General Contractor will provide to GPISD Planning & Construction and Police Department, prior to “ACCEPTANCE” of the project, a copy of the agreement between the General Contractor and the Security Contractor that will provide warranty service. The Security Contractor that will provide warranty service may be other than PRIME project security contractor. Warranty Service Provider will be required to meet all requirements of an AUTHORIZED RADIONICS/BOSCH DEALER utilizing factory trained personnel/technicians – NO EXCEPTIONS.

M. General Contractor and/or Architect will provide Names, Addresses and Emergency Telephone Numbers of all primary contacts for Architects, General Contractors, Contractor(s), Sub-Contractor(s) and any other party (ies) involved in the installation of the system.

N. Wire Requirements:

1. All wire will be Underwriters Laboratories approved for the purpose it is used.
2. Data backbone wiring will be six (6) conductor, shielded cable with bleed wire, 18
3. AWG, stranded, and CL2P low smoke plenum cable. Jacket color should be Grey. Other colors may be approved by GPISD Police Department Alarm Division. Red will not be allowed. Conductor colors will be RED, GREEN, and BLACK, WHITE (Or Yellow), BLUE, & BROWN. Red will be sensor power POSITIVE, Black will be sensor power NEGATIVE, White will be DATA POSITIVE, Green will be DATA NEGATIVE, BLUE, & BROWN will be used for cable supervision. BLUE, & BROWN will be connected to a board point (Points 1 – 8) or POPIT point. It will be programmed as a 24 Hour Supervision Point. Point resistor (EOL) will be place at the furthermost end of the cable from the panel and location.
4. Zone loops will be 22AWG. (Or larger), four (4) conductor non-shielded, CL2P Low Smoke plenum cable. Jacket color should be White. Red will not be allowed.
5. Conductor colors will be RED, BLACK, GREEN & WHITE (or Yellow). RED will be sensor power POSITIVE, BLACK will be sensor power NEGATIVE, WHITE (Yellow) & GREEN will be ALARM CONTACTS.
6. Ground wire shall be 16 AWG. Or larger solid copper. Panel will be grounded in accordance with RADIONICS/BOSCH INSTALLATION GUIDE and NEC CODE requirements.
7. All cable/wiring will be tested by vendor/contractor/sub-contractor with a meter for continuity, grounds, shorts and opens. Documentation will be provided to GPISD Police Department Alarm Division of test results. Any cable/wiring that does not pass will be replaced in its entirety and re-tested.
8. All wiring will be run in a manner as not to allow wire to be in contact with fluorescent lights or other data generating wiring/devices (data, telephone, video, etc.), steam, hot water or any other attachment that could or will cause damage, decay or interference. Wire runs in open/plenum ceilings should be run in a support ring, cable tray (NOT SHARED) or other devise. Cable runs may not rest on grid (lift out) “T-Bar” ceiling supports. Wire/Cable WILL BE protected where deemed necessary to prevent damage. Wire to be run in conduit or metal wire mold as required. Plastic molding will not be allowed.
9. Power supply wire not part of six conductor data cable must be approved by GPISD Planning & Construction and GPISD Police Department Alarm Division PRIOR to installation. Wire/Cable will be 18 AWG. Or larger, two (2) conductor, CL2P rated plenum cable. Jacket color optional (RED not allowed) to be approved by GPISD Police Department Alarm Division. Conductor color will be RED (White) & BLACK. Red (White) will be POSITIVE and Black will be NEGATIVE conductors.
10. All data cable wire runs WILL be in a continuous loop where possible.

"T- Tapping" will not be allowed. NO EXCEPTIONS

11. Shield/Bleed Wires will be continuous, insulated and grounded only at the panel. No existing wire may be used. EXCEPTION – Case by Case ONLY with prior approval of the GPISD Planning & Construction and Police Department Alarm Division. Wire exposed less than seven (7) feet above grade/floor or in risk of damage (by any means) will be in approved conduit/wire mold. Pull strings will be placed on all data cable wire runs. Use of existing pull strings will be replaced. All splice points WILL BE SOLDERED and insulated. A splice point is defined as where three (3) or more wires are connected at a common point.
12. Security Contractor will provide any and all telephone/data/communications cables required for Security System(s). Contractor will run 8 conductor, plenum rated Cat 5 cable(s) to the nearest Telephone/Data/Communications IDF/MDF. Coordination with the GPISD. Telecommunications Department is required – NO EXCEPTIONS. Contractor will provide necessary jack(s) and terminate cable(s) on both ends. Conduit may not be less than 3/4" in size. Conduit between non-connecting buildings to building will be not less than 2" in size.
13. Wire mold will be of a color suitable to the decor. Conduit/Wire Mold will be dedicated to security alarm system ONLY. No sharing of conduit/wire mold will be allowed. This includes, but not limited to, floor, wall, underground and roof penetrations.
14. Conduit/Wire Mold required for system(s) installation(s) WILL BE the responsibility of the SECURITY CONTRACTOR - NO EXCEPTIONS.
15. The Security Contractor may contract the installation of the conduit/wire mold to others.
16. ANY EQUIPMENT AND/OR CONDUIT PULL BOX SUBJECT TO VANDALISM WILL REQUIRE TAMPER RESISTANT AND/OR LOCKED ENCLOSURES. This includes but not limited to outdoor manholes, ground level pull boxes, etc. Enclosures outdoors, subject to weather, humidity and any other adverse condition WILL require weather resident enclosures. Sharing of any pull boxes by any other systems/trades WILL NOT BE ALLOWED – NO EXCEPTIONS Where applicable industry standard concrete, or tile cable duct may be used. Minimum tube size for concrete/tile duct must be two (2") inches. Use of these products will require prior approval of GPISD Planning & Construction and GPISD Police Department Alarm Division.
17. Conduit, wire mold, concrete/tile duct, floor duct, distribution rings and any other devise containing wire/cabling may not be more than seventy-five per cent (75%) occupied.
18. High voltage electrical power (90vac +) required for any/all portions of the security alarm project and conduit (etc.) between non-connecting buildings/wings will be the responsibility of the PROJECT ELECTRICAL CONTRACTOR.
    a) EXCEPTION: If there is no project electrician, the Primary Security Contractor WILL be responsible for all high voltage circuits (110vac). Installation may be contracted to others (Electrical Contractor). ALL ordinances, permits, laws and AHJ regulations will be followed.

1.3 OTHER EQUIPMENT

A. Alarm sensors Brand, Type, Range will be approved by GPISD Police Department Alarm Division PRIOR to installation and may be of the following or combination as job requires. Shall be of the latest revision or replacement for the Make/Model listed below.

B. The following is applicable at the time of the document revision 05/06 and subject to change by manufacturer prior to installation. Substitution of specified product will

require notification and approval of the GPISD Planning & Construction and GPISD Police Department Alarm Division PRIOR to installation of substituted part(s).

C. During warranty period, if original part is no longer available, the contractor WILL use the latest version/replacement available from the manufacturer.

D. The following is a list of standard equipment used by GPISD Planning & Construction and GPISD Police Department Alarm Division. See Job worksheet(s) for specific equipment to be used:
   1. Bosch D9360 360-degree Ceiling Mount
   2. Bosch – ISC-CDLI-WA126 Commercial Series Tri-Tech
   3. Bosch Photobeam 5000 Beams.
   4. Bosch OD850 outdoor Tri-Tech for outdoor applications as needed.
   5. Any other sensor approved or specified by GPISD Police Department Alarm Division.
   6. GRI 4532 door contacts (NC).

1.4 ACCESS CONTROL EQUIPMENT. (WHERE REQUIRED ON A PER JOB BASIS)

A. All Access Control Systems Must Be Installed in accordance with ALL local, city, state and Authority Having Jurisdiction laws, regulations, codes, standards, and ordinances. Coordinate emergency door release with the fire system contractor and/or GPISD Police Department Alarm Division.

B. All interface readers, electronic locks, etc. and other associated equipment must be compatible with the RADIONICS/BOSCH control panel(s). WIEGAND 26-bit format will be used. Systems larger than thirty-two (32) doors will have an additional set of specifications from this section. All door hardware and locking mechanisms MUST meet GPISD Locksmith's specifications.

C. Equipment as required per project may include:
   1. Panel (Existing in CTE Building MDF 1807) –BOSCH B9512G – No Exceptions.
   2. Access Control Module BOSCH B901
   3. Card readers - HID 5365EGP00
   4. Door release buttons - USP HUB2SA

D. To be mounted above door to be controlled. Any other location will require written PRIOR approval of GPISD Police Department.
Access Control cards shall be HID 9520
HID 5365 Mini Prox Readers
(Confirm, with GPISD Police Department Alarm Division current reader type to be used at all locations or various types at specific locations)

E. HID Proxkey II Proximity Key fob - Quantity to be determined on a per project basis. Minimum of two hundred (200) units (key fobs) required.

F. Locking hardware is Von Duprin or Hess brand or approved by GPISD Planning & Construction and GPISD Police Department Alarm Division. It will be of the 12vdc version. Door strikes will be of the "FAIL SECURE" type. All locking hardware will be provided by the primary security contractor – NO EXCEPTIONS.

G. Use of Magnetic Locks on glass and/or aluminum doors is not recommended and will require PRIOR approval of the GPISD Police Department Alarm Division.

H. Wire and cable must be of the type used for Access Control equipment.

I. Power supplies must be of the type listed for Access Control Equipment. ALTRONIX brand and models are recommended.

J. "Request to Exit" devises, i.e. Buttons, P.I.R.s, etc. must be U. L. Listed and approved by the AHJ for use in access control systems.

K. Surge suppressors must be used on electronic locks per manufactures requirements.

L. Request to Exit" P.I.R. to be Detection Systems DS 1501 (Grey) or DS 1511(White) as needed to blend with decor.

M. "Bio" readers (fingerprint, palm, retina eye scan, etc.) will be specified on a case-by-case basis.

N. All equipment will be securely mounted. No glue or double-sided tape will be allowed. Plastic anchors will not be allowed on equipment mounted on the exterior of the building, to mount power supplies, POPIT or communicator enclosures.

O. Reuse of existing sensors, power supplies or other equipment may be approved on a case-by-case basis.
P. All equipment subject to abuse will be enclosed in protective boxes, screen cages or other enclosures of the type to be approved by GPISD Planning & Construction and GPISD Police Department Alarm Division. Also see Section 13 for additional requirements.
Q. Power Supplies:
1. Power Supplies will be of sufficient size to meet the load demand with a twenty percent (20%) reserve capacity. Brand/Type/Model to be approved by GPISD Police Department Alarm Division.
2. Mount in a location and height for ease of service. Height shall not exceed the ability of service from a six (6) foot ladder.
3. Minimum back-up battery size of 12VDC7Ah. Transformers will be either hardwired or secured to the outlet

1.5 HIGH VOLTAGE ELECTRICAL:
A. Dedicated electrical power associated with security alarm system WILL BE required. Any electrical work must meet NEC, City of Houston or other AHJ and be approved by the GPISD Planning & Construction and Maintenance Department.
B. high voltage (90vac +) will be connected to a “hot” breaker only by the project electrical contractor. conduit and wiring may be installed by others. see section 11 for exceptions.
C. ANY and ALL high voltage circuits associated with the security systems(s) must be labeled at the breaker panel. Location of breaker panel and breaker number(s) MUST be included on the “as built” drawings – NO EXCEPTIONS.
D. Contractor will provide a copy of the programming and database PRIOR to the system(s) being programmed. Contractor will coordinate all programming and data base with the GPISD Planning & Construction and Police Department. All programming will be done by the contractor with the exception of system users. System users and their pass cards will be programmed by the Galena Park ISD Police Department.
E. Security alarm programming requirements:
F. All Galena Park ISD projects are to be programmed as follows:
G. Alarm point programming will use point indexes:
1. 7 = perimeter instant
a) Point type 1
b) Point response 2
c) Point index 7 is used for all interior motion detectors, interior, and exterior door contacts.
2. 25 = entry exit delay point
a) Point type 1
b) Point response 5
c) Entry delay 60 seconds
d) Point index 25 is used for perimeter entry exit doors or doors leading to a secure area.
3. 13 = interior follower
a) Point type 3
b) Point response 5
c) Entry delay 60 seconds
d) Point index 13 interior follower is used for alarm points associated with entry exit delay points.
H. Alarm point indexes 7 and 13 are to be programmed yes for:
1. Bypassable
2. Swinger bypass
3. Bypass returnable
4. Force arm returnable
I. Point descriptions (signage):

1. It is the responsibility of the contractor to verify that the room signage has not changed during the course of the project, any discrepancies between room signage and programmed alarm point text will be corrected by the contractor at his own expense.
2. Point descriptions are to match room signage and architectural drawings with device code and location in a room with multiple devices.
    a) Example: A 302NW DC
    b) A = section
    c) 302 = room number
    d) NW = location of device in room
    e) DC = door contact (device code)
    f) Another example: A3 CORR SE
    g) A3 = section and floor
    h) CORR = corridor
    i) SE = location in corridor

J. These examples pertain mainly to classrooms and corridors, when dealing with administrative offices, mechanical rooms, kitchen areas etc. use the room name:
1. A100 CLINIC
2. F100 DRY STOR
3. A112 MECH RM

K. Since 90% of all alarm devices are motion detectors there is no need to distinguish it in the point description, however it is very important to distinguish door contacts for custodial and staff to recognize doors that need to be secure in order to arm an area.

L. Device codes:
1. DC = door contact
2. GB = glass break sensor
3. All alarm devices and keypads are to be assigned to their appropriate areas.
    a) 1 main building
    b) 2 = kitchen
    c) 3 = gym/pe
    d) 4 = band/orchestra or fine arts
    e) 5 = security office

M. Master keypads will be located in specified areas of the building for custodial and staff to arm and disarm multiple areas. Including but not limited to:
1. Custodial office
2. Administrative office

N. As built drawings are to be submitted to not only the general contractor but to GPISD Police Department Alarm Division with correct room signage and device location in order for jobs acceptance.

O. Any deviations of the scope of work must be approved in writing by GPISD Police Department Alarm Division: in blue print and auto cad form with correct room signage and device location in order for jobs acceptance.

P. It is the responsibility of the security contractor to notify GPISD Police Department Alarm Division, prior to the installation of ANY portion of the project that may result in a lack of 100% performance of any equipment/wire/cable/sensor/location/view/range. (Example- Motion detector with object blocking views [projection screen, television, door, wall, etc.]). Failure to notify GPISD Police Department Alarm Division will result in the contractor correcting the problem at his expense.

Q. GPISD Police Department Alarm Division WILL have final authority for:
1. Approval of all submittals, plans and specifications.
2. Parts/equipment brand, model, number and placement of same.
3. Cable and wiring.
4. Approval of changes and/or substitutions to any part of the project.
5. Acceptance of installed system.
6. Acceptance of programming and Data Base.

1.6 WARRANTY

A. Contractor will maintain sufficient spare parts in order to facilitate warranty repairs in a timely manner.

B. Contractor will provide warranty and service for all parts and labor within forty-eight (48) hours notice for a period of one (1) year from the date of SUBSTANTIAL COMPLETION by GPISD Police Department Alarm Division.

C. WARRANTY PERIOD BEGINS AT THE TIME OF SUBSTANTIAL COMPLETION OF THE SECURITY ALARM PROJECT BY THE GPISD POLICE DEPARTMENT ALARM DIVISION AND IS INDEPENDENT OF ANY OTHER WARRANTY SPECIFIED IN OTHER SECTIONS OF THE JOB DOCUMENT AND/OR CONTRACT.

1.7 APPROVED CONTRACTORS

A. GPISD Planning & Construction and GPISD Police Department Alarm Division shall approve all security contractors.

B. GPISD Police Department Alarm Division, in order not to show bias toward any contractor(s), provides a means for contractor(s) to become approved to do business with GPISD Police Department Alarm Division. Contractor wishing to be placed on GPISD Police Department Alarm Division's list of APPROVED contractors and meet any/all qualifications/specifications must follow procedures set forth in document "Application for Approved Contractor – GPISD Police Department Alarm Division".

C. Applications must be submitted no later than 60 days prior to bid process in order to review applications and verify documentation. – NO EXCEPTIONS

1.8 Removal from "Approved Contractors Lists":

A. Contractor(s) may be removed from the "APPROVED CONTRACTOR LIST" at anytime for "CAUSE". This includes, but not limited to (a) violation of specification(s), (b) false statements/documentation, (c) not completing projects in a timely manner and/or (d) any reason that would result in GPISD Police Department Alarm Division and/or Galena Park Independent School District not receiving the quality of workmanship/service/equipment required by these specifications.

1.9 Security Intercom System for Doors

A. Main entrance shall have an Aiphone Audio Intercom Door stations, with video; hardwired; one master station at reception with a secondary slave station (location determined by GPISD Planning & Construction during design phase).

B. Kitchen shall have an Aiphone Audio Intercom Door stations, with video; hardwired; one master station at sty the kitchen manager's office.

C. Intercom system shall have full 2-way audio capabilities

D. System shall be as manufactured by Airphone

END OF SECTION

SECTION 31 11 00 - CLEARING AND GRUBBING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Protecting and preserving trees and vegetation designated to remain.

B. Clearing of site, including, but not limited to the removal of trees, shrubs, and vegetation which is not designated to remain, and brush, branches, logs, rock, debris, rubbish and other objectionable material from the entire project area.

C. Grubbing of site, including, but not limited to uprooting and removal of all stumps, roots, other organics, etc. to their full depth from the project area and disking to a depth of nine (9) inches.

D. Removal and legal, satisfactory disposal of all material cleared and grubbed from the site.

1.2 PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION

3.1 CONDITIONS AT SITE

A. Execute all work in an orderly and careful manner with due consideration for any and all surrounding areas, planting or structures which are to remain. Periodically, water as required to allay dust and dirt. Protect any adjacent property and improvements from damage and replace any portions damaged through this operation.

B. Coordinate and comply with the following:
   1. Geotechnical Report.
   2. Local ordinances and requirements of authorities having jurisdiction.

C. The Contractor shall take proper precautions to protect adjacent or adjoining property from damage caused by clearing and grubbing activities. All damage shall be repaired or replaced at Contractor's expense.

D. The Contractor shall be responsible for obtaining all permits required by State and local governing agencies.

3.2 DISPOSAL OF MATERIAL

A. All cleared and grubbed material becomes the property of the Contractor and shall legally and satisfactorily be removed and disposed of off-site. **On-site burning will not be permitted**.

3.3 FINAL SITE PREPARATION

A. Remove all rubbish, debris, etc., resulting from Work of this Section from the site.

B. After clearing, grubbing and discing the project site, rake and pick the entire site to remove all debris material.

END OF SECTION 31 11 00

SECTION 31 13 13.13 - WASTE MATERIAL DISPOSAL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. Waste material disposal consists of disposal of trees, brush, vegetation, rubbish and other objectionable matter from operations such as clearing and grubbing, demolition, excavation, concrete placement and grading. Unless otherwise specified, the Contractor is responsible for removal and disposal of waste material.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Specific products are not required. Use equipment and materials necessary to properly complete disposal of waste materials.

PART 3 - EXECUTION

3.1 DISPOSAL AREA

A. Items noted on plans to be "removed" or “disposed” will be taken completely off the site.

B. Concrete wash-out will become property of Contractor to be disposed of with other waste materials.

3.2 COMPACTION AND GRADING

A. Level off waste material to an elevation 12 inches below final grade. Place excess topsoil on waste material in a layer not less than 12 inches thick and compact to the density of the surrounding area.

END OF SECTION 31 13 13.13

SECTION 31 20 00 – EARTHWORK (UNDER PAVING AND SITE APPURTENANCES)

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This section includes the furnishing of all plant, labor, equipment, materials and the performance of all operations required to complete the Earthwork indicated on the Drawings and specified herein, including the following: Clearing and Grubbing, Stripping, Excavation, Embankment, Borrow, Subgrade Preparation, Compaction and Finish Grading.

PART 2 – PRODUCTS
Not Used

PART 3 – EXECUTION

3.1 CLEARING & GRUBBING

A. This item shall consist of clearing the ground of all trees, brush, rubbish, and of grubbing the roadway, pavement areas, roadside ditches and/or outfall ditch right-of-way or other easements as designated within the limits of the project. The designated areas shall be cleared of stumps, brush, logs, rubbish, trees and shrubs, except such trees and shrubs and certain areas designated by the Engineer for preservation shall be carefully protected from abuse, marring or damage during construction operations. Continual parking and/or servicing of equipment under the branches of trees designated for preservation will not be permitted. Trees and shrubs designated for preservation, that must be pruned, shall be trimmed as directed by the Engineer and all exposed cuts over two (2) inches in diameter shall be treated with an approved material.

B. On areas required for paving, channel, or structural excavation, all stumps, roots, etc., shall be removed to a depth of approximately 2-feet below the lower elevation of the excavation. On areas required for embankment construction, all stumps, roots, etc., shall be removed to a depth of approximately 2-feet below the existing ground surface. All holes remaining after clearing and grubbing shall be backfilled and compacted to ninety percent of Standard Proctor Density (ASTM Method D698) at a moisture content of between optimum and plus 3 percent of optimum as directed by the Engineer and the entire area bladed to prevent ponding of water and to provide drainage; except in areas to be immediately excavated, the Engineer may direct that the holes not be backfilled. On areas required for borrow sites and material sources, stumps, roots, etc., shall be removed to the complete extent necessary to prevent such objectionable matter becoming mixed with the material to be used in construction.

C. All cleared and grubbed materials shall be disposed of off site. Contractor shall be responsible for obtaining any necessary disposal permits. The Contractor shall not bury any refuse on site. No burning shall be permitted unless specifically noted and permitted by local jurisdictions.

D. No separate measurement or payment will be made for furnishing all labor, materials, permits, supervision, equipment and supplies required to complete all items of work specified for clearing and grubbing.

3.2 STRIPPING

A. Within the limits indicated, or in areas where existing grade is to be altered either by excavation or embankment, the Contractor shall strip existing topsoil to approximately 3-inches in depth, except that areas beneath foundations or structures shall be stripped to a minimum depth of 6-inches, and may be stockpiled for future use or disposed of at the Contractor's expense. Stripping shall include the removal and disposal of scrap iron, rubbish, logs, abandoned utilities, signs, and any and all other debris, if within the project site or right-of-way, whether above or below existing grade. Stripping and excavation can take place in the same operation, provided the topmost material is suitable for use in future construction and provided it is not to be set aside for backfill or topsoil. The upper topsoil and debris to be stripped as noted above, shall be removed regardless of whether the site is to be excavated or receive embankment. Surface soil, not suitable for use in the future construction and any other unsatisfactory material shall be excavated, removed off the site and placed in designated spoil banks or shall otherwise be disposed of as directed by the Engineer in such a manner as not to create an unsightly or objectionable condition.

B. Stripping will not be paid for directly. Payment for stripping shall be subsidiary to excavation, borrow or embankment.

3.3 EXCAVATION

A. Excavation shall consist of the required excavation within the project limits, the removal and proper utilization or disposal of all excavated materials; and the constructing, shaping and finishing of all earthwork on the entire project site, in conformity with the required lines, grades and typical cross sections, and in accordance with the specification requirements herein outlined. All suitable excavated materials shall be utilized, insofar as practicable, in grading the site, uniformly widening embankment, flattening slopes, etc., or as directed by the Engineer. The Engineer will define suitable materials. Unsuitable excavation in excess of that needed for construction shall be known as waste and shall become the property of the Contractor to be disposed of by the Contractor outside the limits of the site. Unsuitable material encountered below subgrade elevation, shall be replaced with material from the excavation, or with other suitable material.

B. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, including preparing ditches, trimming of slopes, disposal of surplus materials (wastage), preparation and completion of subgrade, shoulders, roadway, any necessary hauling and the furnishing of all labor, tools, equipment and incidentals necessary to complete the work.

3.4 EMBANKMENT

A. This item shall govern for the placement and compaction of all materials obtained from the site, borrow, channels, structural and sewer excavation, including all underground utility excavation, used in the construction of project fill and/or embankment. Prior to placing any embankment, all stripping and/or clearing and grubbing operations shall have been completed on the excavation sources and areas over which the embankment is to be placed. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable material and thoroughly compacted by approved methods before commencing embankment construction.

B. Unless otherwise indicated on the plans, the surface of the ground of all unpaved areas, which are to receive embankment, shall be loosened by scarifying or plowing to a depth of not less than 4-inches. The loosened material shall be recompacted with the new embankment as hereinafter specified and shall not exceed 8-inches in total depth. Where indicated on the plans or as directed by the Engineer, the surface of a hillside to receive embankment shall be loosened by scarifying or plowing to a depth of not less than 4 inches, or cut into steps, benched or notched before embankment materials are placed. The embankment shall then be placed in layers, not to exceed 8-inches, as hereinafter specified, beginning at the low side in part width layers and increasing the

widths as the embankment is raised. The material, which has been loosened, shall be recompacted simultaneously with the embankment material placed at the same elevation. Where embankments are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be plowed or scarified to a depth of not less than 4-inches and the embankment built up in successive layers, as hereinafter specified to the level of the old roadbed before its height is increased. The top of the old roadbed shall be scarified and recompacted with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible depth of layer.

C. Trees, stumps, roots, vegetation or other unsuitable materials shall not be placed in the embankment.

D. Except as otherwise required by the plans, all embankment shall be constructed in layers approximately parallel to the finished grade of the site or paving. Embankments shall be constructed to the grade established by the Engineer and completed embankments shall correspond to the general shape of the typical sections shown on the plans and each section of the embankment shall correspond to the detailed section or slopes established by the Engineer. After completion, the site shall be continuously maintained to its finished section and grade until the project is completed.

E. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position, but all such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken, and the embankment material mixed by blading, harrowing, discing, or similar methods to the end that a uniform material is secured in each layer. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied and it shall be the responsibility of the Contractor to secure uniform moisture content throughout the layer by such methods as may be necessary.

F. After each layer of embankment or select material is complete, the Engineer will make tests as necessary. If the material fails to meet the density specified, the course shall be reworked, as necessary, to obtain the specified compaction. Should the subgrade, due to any reason or cause, lose the required stability, density or finish before the pavement is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent layer of asphaltic or other approved material. Embankment shall not be paid for directly, but shall be incidental to site excavation, channel excavation, construction of underground utilities, including all sewers, or borrow.

3.5 BORROW

A. Borrow shall consist of the required excavation, removal and proper utilization of materials secured from sources obtained by the Contractor and approved by the Engineer. Borrow shall be used only when shown on the bid form or directed by the Engineer and then only from approved sources. Borrow material shall come only from sources approved by the Engineer. The Engineer shall provide samples of the fill material for testing and approval. In the event the material is not acceptable, as determined by the Engineer, the Contractor shall find other sources. All fill material shall be free from organic matter and deleterious material.

B. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price. All work performed as required herein shall be full compensation for furnishing all labor, for all materials, for all royalties and freight involved, for all hauling, delivery, spreading and compacting complete and in place and for all tools, equipment and incidentals necessary to complete the work.

3.6 SUBGRADE

A. The subgrade shall be brought to the lines, grades and typical cross section shown on the plans and in accordance with these specifications. Whenever unsuitable natural material is encountered and cannot be handled by the excavation or embankment requirements, then the following requirements shall apply. The unsuitable material shall be excavated to a depth deemed sufficient by the Engineer and the excavated material shall be disposed of off the jobsite at the expense of the Contractor. The excavated area shall be filled to its original level with suitable material meeting the requirements of borrow. This imported material shall be compacted to 95-percent of standard proctor density, (ASTM Method D698) using a moisture content ranging from optimum to plus 3-percent above optimum. Soils shall not be compacted at less than the optimum moisture content.

B. After all holes and depressions are filled with approved material, the subgrade shall be brought up to the lines and grades required and if it is not to be stabilized, it shall be compacted to 95-percent of standard proctor density, (ASTM Method D698), using a moisture content ranging from optimum to plus 3-percent above optimum. The subgrade, without stabilization, shall be compacted to a depth of 9-inches. The subgrade shall be kept free from all ruts and weak spots. Any ruts and weak spots that develop under traffic shall be repaired with suitable material as they develop.

3.7 COMPACTION

A. All fill material shall be placed in uniform layers, dried or moistened as required to obtain approximate optimum moisture content and rolled to a density of at least 95 percent of maximum density at optimum moisture as determined by ASTM D-698. Compaction equipment shall be as hereinafter specified. The maximum thickness of uniform layers (loose measurements) shall be as follows:
   1. If the Contractor elects to use a pneumatic tired roller, the thickness of each uniform layer shall not exceed six (6) inches.
   2. If the Contractor elects to use sheepsfoot rollers, the thickness of each uniform layer shall not exceed eight (8) inches.
   3. In locations where it is impractical to use the roller equipment, mechanical hand tampers will be used, and the thickness of each uniform layer shall not exceed four (4) inches. The method used to secure the optimum moisture content will be the Contractor's responsibility. The compacting equipment and the method of compaction shall be such that a uniform density will be obtained over the entire area and depth of material being compacted. All fill material deposited in place by means of scrapers, dump trucks, draglines or other similar equipment shall be thoroughly broken up before being spread into the uniform layers. Rolling shall start longitudinally at the sides and proceed toward the center of the crowned sections or start longitudinally at the low side and proceed toward the high side of sloped areas, overlapping on successive trips by at least one-half (1/2) the width of the roller unit. Alternate trips of the roller shall be slightly different in length.

B. Excess loss of moisture shall be construed to exist when the soil moisture content is three (3) percent less than optimum moisture.

C. An independent qualified Testing Laboratory either selected by or approved by the Owner or Engineer, for every 500 square yards of the compacted subgrade shall take density tests. The Testing Laboratory will furnish written reports covering results of all tests and inspections made. Reports will be made promptly to the Engineer, Contractor and Owner.

3.8 FINISH GRADING

A. Uniformly smooth grade all areas indicated on the drawings to be graded. The finish surface shall be not more than 0.05 feet above or below the established grade or approved cross section. All ditches and swales shall be properly graded so as to drain readily. Where existing grade is

disturbed by the Contractor in areas not marked to be graded, the Contractor will regrade the disturbed area to its original grade at no additional expense to the Owner.

B. Top Soil for general grassed areas shall be yard mix (70% sharp sand 30% soil) at least 2” thick and free of rocks, concrete and debris or existing on site top soil. Bank sand is not acceptable.

C. Finish grade shall be smoothed and neatly hand-tamped along the edges of walks, drives, pavements and structures.

D. A slope of not less than 1/4" per foot shall be provided at the perimeter of all structures

E. Prior to finish grading the Contractor shall remove all construction debris i.e., concrete slag, banding straps, wood framing, trash, rocks ½” diameter or bigger, etc., from the site. An inspection by GPISD is to be required prior to finish grading.

END OF SECTION 31 20 00

SECTION 31 22 16.13 - ROADWAY EXCAVATION

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Roadway excavation shall consist of the required excavation within the limits of roadway including roadway ditches (excluding excavation designated as channel excavation, structural excavation, etc.), the removal and proper utilization or disposal of all excavated materials; and the constructing, shaping and finishing of all earthwork on the entire length of roadway and the approaches to same, in conformity with the required lines, grades and typical cross section and in accordance with the specifications requirements herein outlined. Compaction of embankments shall be as outlined in Section 110 – Roadway Excavation from the Harris County Engineering Department, dated 2016 or the latest revision. The roadway is defined as being from right-of-way line to right-of-way line.

1.2 MEASUREMENT

A. All roadway excavation will be computed by the method of average end areas. Field cross sections will be taken at the end of the stripping operation and at the end of the project. It is on the basis of these cross sections that computations will be made for the roadway excavation quantities in cubic yards.

1.3 PAYMENT

A. All work performed as required herein, and measured as provided above, will be paid for at the Unit Price Bid for "Roadway Excavation", which price shall be full compensation for preparing roadside ditches, trimming of slopes, disposal of surplus materials (wastage), preparation and completion of subgrade, shoulders, roadway, all hauling and the furnishing of all equipment, tools labor and incidentals necessary to complete the work.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. All roadway excavation and corresponding embankment construction shall be performed as specified herein and in accordance with SECTION 31 20 00 - EARTHWORK and the completed roadway shall conform to the established alignment, grades and cross section.

B. All suitable excavated materials shall be utilized, insofar as practicable, in constructing the required roadway sections or in uniformly widening embankment, flattening slopes, etc., or as directed by the Engineer. Suitable materials will be defined by the Engineer. Unsuitable roadway excavation and roadway excavation in excess of that needed for construction shall be known as waste and shall become the property of the Contractor to be disposed of by the Contractor outside the limits of the right-of-way unless directed otherwise. Unsuitable material encountered below subgrade elevation, shall be replaced with material from the roadway excavation, or with other suitable material.

C. During construction, the roadbed and ditches shall be maintained in a condition to insure proper

drainage at all times. Ditches and channels shall be so constructed and maintained as to avoid damage to the roadway section. All roadway excavation utilized as embankment shall be placed in accordance with SECTION 31 20 00 - EARTHWORK.

D. In those cases where the Contractor has over-excavated beyond the lines and grades shown on the drawings, or designated by the Engineer, it shall be the Contractor's responsibility to replace the material and recompact it at his own expense. The material shall be replaced in accordance with SECTION 31 20 00 – EARTHWORK.

3.2 SPECIAL ROADWAY EXCAVATION

A. When geotechnical conditions dictate, the Engineer may direct the Contractor to excavate material, which will not properly support the roadway, and replace it with other material. In those cases, the additional excavation shall be paid for under the Unit Price Bid. The material used to replace the excavated material shall be in accordance with these Specifications and shall be paid for as provided under "Borrow" i.e. measured in place by the method of average end areas. The material shall be replaced in accordance with SECTION 31 20 00 - EARTHWORK.

END OF SECTION 31 22 16.13

SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This Section shall govern for all excavation required for the construction of sewers, sewer structures, pipe culverts, appurtenances and connections and for the backfilling around completed sewers to the level of the original ground, all in conformity with the locations, lines and grades shown on the plans or as given by the Engineer and in accordance with these specifications. This Section shall also govern for any necessary pumping or bailing and drainage and all sheathing and bracing of trench walls. Also governed by this Section are the cutting and restoration of pavement and base courses, the furnishing and placing of cement stabilized backfill, the hauling and disposing of surplus materials and the bridging of trenches and other provisions for maintenance of traffic or access as provided herein.

1.2 QUALITY ASSURANCE

A. The Testing Laboratory's representative will determine the moisture density relationship in accordance with ASTM D698 on material secured from the trench excavation. Samples secured from the cement stabilized sand supplier shall be blended with Portland cement in accordance with Section 31 23 23.16 - Cement Stabilized Sand Bedding and Backfill, and the moisture density relationship will be determined in accordance with ASTM D558.

B. The Testing Laboratory's representative will determine the in-place density in accordance with ASTM Methods D2922 or D1556. The minimum level of testing will consist of at least one test for each 200 linear feet of trench per lift of backfill.

C. At the completion of the project, all on site storm and sanitary sewer lines shall be cleaned out using a hydraulic jet machine in the presence of the owner and engineer. After hydro-jetting storm and sanitary sewer lines, all segments shall be video tape recorded and tapes shall be furnished to the owner.

1.3 REQUIRED INSPECTIONS

A. The contractor is solely responsible for meeting with all inspecting authorities having jurisdiction over the project (to include, but not limited to: Water District, City, County, State and Federal) prior to construction. All required inspections shall be coordinated by the contractor prior to installation of the WORK. All WORK found to be deficient by the inspector(s) and WORK installed prior to notification of inspector(s) shall be removed and replaced at the contractor's sole expense.

PART 2 – PRODUCTS

2.1 CONNECTIONS TO BUILDING GRAVITY SEWERS

A. Connections to building gravity sewers, to include roof drains and sanitary sewer connections shall be made with SCH 40 X SDR adapter couplings.

B. Fernco couplers are not allowed.

PART 3 – EXECUTION

3.1 EXCAVATION & TRENCH PREPARATION

A. Excavate trench to the alignment and depth required. Brace the trench and drain, as required, so that the work may be accomplished safely and efficiently. If necessary, install a dewatering system to provide a dry trench bottom. Pumps shall discharge into natural drainage channels or to drains. Shoring for excavations and trenches shall meet the requirements of the latest edition of OSHA Regulation 1926, Subpart P.

B. For pipes less than 30 inches in diameter, the minimum width of the trench shall be the width of the outside barrel of the pipe plus 24 inches, the maximum width of the trench shall be the width of the outside barrel of the pipe plus 36 inches. For pipe 30 inches and larger, the minimum trench width shall be the width of the outside barrel of the pipe plus 32 inches, and the maximum width of the trench shall be the width of the outside barrel of the pipe plus 36 inches.

C. Side sloping or benching of the trench, where permitted, will begin at one foot above the top of the pipe and will not encroach upon private property or endanger existing or future structures or underground utilities. Depth of trench, without sheathing or bracing shall comply with OSHA Regulation 1926.650.

D. The full width of the trench shall be excavated to a depth below the invert elevation of the pipe so as to permit placing the bedding material specified on the attached drawings below the outside bottom of the pipe. Any additional depth excavated by the Contractor shall be replaced with an equal depth of cement-stabilized sand. The cost of this additional material, in place shall be at the expense of the Contractor.

E. Where necessary, excavations shall have sheathing and bracing to prevent caving. At these locations, increase the trench width as required and leave the sheathing in place until the pipe has been laid and the backfill compacted to a depth of 2 feet over the pipe. All sheathing and bracing shall be designed to the requirements of OSHA Standard 1926, Subpart P (latest edition).

F. Sewers shall not be constructed, or sewer pipe laid in the presence of water. All water shall be removed from the excavation sufficiently prior to the sewer placing operation to ensure a dry, firm bed on which to place the sewer and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point system as conditions warrant. There will be no separate pay for well pointing without the prior approval of the Engineer. Contractor shall include in base proposal all costs associated with de-watering, well pointing, stabilizing, etc. necessary to install all underground utilities.

G. In the event that the excavation cannot be dewatered to the point where the pipe subgrade is free of mud, excessive wet soil, sand silt or clay with water, a seal slab shall be used in the bottom of the excavation. Such seal slab shall consist of a lean concrete mixture. The seal slab shall be a Class “D”, 5 sacks of cement per cubic yard with a minimum compressive strength of 1,750 P.S.I. at 7 days and 2,500 P.S.I. at 28 days. A precast seal slab may be used, provided that the joints of the seal slab do not occur at the joint of the pipe. Contractor shall have an option of using a three-day cylinder break test at no expense to the Owner.

H. For unstable conditions requiring outside forms, seals, sheathing, and bracing, or where groundwater is encountered, any additional excavation in width and backfill required shall be done at the Contractor’s expense. Portable trench boxes may be used in lieu of sheathing upon approval in writing by the Engineer. The trench box must be in accordance with OSHA Regulation 1926.650 (latest edition).

I. Use of the trench box does not relieve the Contractor of any liability for damages to person or property. When a trench box is moved, the jointed pipe or in-place backfill shall not be disturbed.

J. All materials from excavation operations not required for backfilling, if considered suitable shall be placed in embankments or wasted, in accordance with Section 31 20 00 - Earthwork. All material not suitable for use in embankments will be declared surplus by the Engineer and shall become the responsibility of the Contractor to dispose of as he wishes. Such surplus material shall be promptly removed from the work following the completion of the portion of the sewer involved. No separate payment shall be made for disposal of this surplus material.

K. Unless otherwise specifically approved, Contractor shall use ladder or wheel-type trench-digging machinery, except where hand methods must be employed to avoid damage to existing structures above or below ground, or where hand excavation is indicated.

L. Engineer may limit the amount of trench opened or partially opened at any time in advance of the completed pipe laying operation and the amount of trench left unfilled. Open no more than 500 feet of trench at any one time.

3.2 PIPE LAYING

A. No pipe shall be laid in water or when the trench conditions or weather is unsuitable for such work, unless specifically approved by the Engineer.

B. Non-pressure concrete pipe shall be laid with the ends abutting and true to line and grade. Fit and lay the pipe to form a smooth and uniform invert. Laying of pipe shall commence at the lowest point, so that the spigot ends point in the direction of flow. Lay cast iron pipe on firm earthen foundation with bell ends facing the direction of laying.

C. All other types of pipe shall be laid in accordance with the applicable provisions of this specification, in accordance with the Special Provisions preceding this Subsection, or with the manufacturer’s recommendations.

D. Cut cast iron pipe with wheel-type cutters or cold chisel. Flame cutting of cast iron pipe is not allowed. Make cuts in a neat and workmanlike manner without damage to pipe and so as to leave a smooth end at right angles to axis of pipe. Field cutting of Polyvinyl Chloride shall be in accordance with the pipe manufacturer's recommendations.

E. Minor deflections may be obtained in pipe joints. Contractor must obtain approval when the degree of deflection is necessary to deflect from a straight line. Where necessary to make major deflections in concrete pipe, use sections of pipe with beveled ends for deflections not greater than five degrees. For deflections greater than five degrees, use fabricated fittings for concrete pressure pipe and use cast iron fittings for cast iron pipe.

F. When the pipe laying operation is halted, seal the open end of the pipe with a temporary plug. Plug is to remain in place until the pipe laying operation re-commences. Standard plugs shall be inserted into bells of all dead-end pipe.

G. All underground pipe shall have a 12-gauge metallic tracer wire running the full length of the pipe. Tracer wire shall be taped to the pipe at intervals not to exceed 15-feet using duct tape and terminate at each end above ground in a 2” PVC riser.

H. Pipe shall be installed with the labels facing upward.

I. At the completion of the project, all on site storm and sanitary sewer lines shall be cleaned out using a hydraulic jet machine in the presence of the owner and engineer. After hydro-jetting storm and sanitary sewer lines, contractor shall run video-camera through pipes and video-record each line segment in order to document proper installation.

3.3 BACKFILLING

A. As soon as practicable after completion of laying and jointing of pipe, backfill the trench. Not more than 200 feet of the trench shall be left open after laying the pipe.

B. Trenches shall be backfilled in accordance with drawing details and notes. Backfill material selected from sewer trench excavation, or obtained from other sources, shall be free from stones, which will interfere with compaction and free of large lumps, which will not break down readily under compaction. Do not use material excavated in large lumps which will not break down or which cannot be spread in loose layers. Material excavated by trenching machine will generally be suitable for use as backfill. Cement stabilized sand shall be in accordance with Section 31 23 23.16 - Cement Stabilized Sand Bedding and Backfill.

C. When placing backfill in the trench simultaneously on both sides of the pipe for the full width of the trench, moisten if necessary and tamp in approximately 6-inch layers, thoroughly compacting under and on each side of the pipe to provide solid backing against the external surface of the pipe. Walking or working on the completed pipeline, except as necessary in tamping or backfilling shall not be permitted until the trench has been backfilled to at least 12-inches over the top of the pipe.

3.4 RESTORATION OF SURFACES

A. Replace or repair sidewalks, driveway culverts, inlets, curbing, gutters, shrubbery, trees, fences, sod and other like obstructions removed or disturbed, to the condition equivalent to that existing prior to commencement of this work. Use concrete having a compressive strength of not less than 3,000 psi in 28 days for the replacement of curbing, gutters, inlets and sidewalks.

B. Use reasonable care in the removal and replacement of shrubbery and trees designated to be replaced at original locations. Where at all possible, ditch alignment will be such as to minimize this work. The restoration of asphalt-topped flexible base and concrete streets shall be as specified under other items of the specifications.

3.5 CLEAN-UP

A. The Contractor shall remove from the site of the work and from public and private property temporary structures, rubbish, and waste materials, including excess excavated materials. The Contractor is responsible for disposing of all surplus earth. The pipe laying operation shall be temporarily suspended if the clean-up is falling behind as determined by the Engineer or Owner.

3.6 MEASUREMENT & PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

END OF SECTION 31 23 00

SECTION 31 23 23.13 - BANK SAND BACKFILL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This Section shall consist of the furnishing, placing, manipulation, compacting and completing in-place, Bank Sand as a bedding and backfill material for water and sewer lines, as construction fill for certain excavation areas, as construction fill for ruts, holes and other similar conditions; as a fill material for project clean-up and as directed by the Engineer. Bank sand shall be in accordance with these specifications and in conformity with the lines, grades and cross-sections shown on the plans and as directed by the Engineer.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Bank sand is to be free of organic matter, foreign material, clay balls, sticks, foreign objects and other objectionable material. Bank sand shall have a plasticity index less than three (3) and shall meet the following gradation: 100 percent passing a 3/8-inch sieve, 5 to 30 percent passing a No. 200 sieve. Prior to use, Contractor shall identify the source of the proposed bank sand for testing.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. After the water line, sewer line or other similar construction item, such as a trench, has been excavated and brought to grade, bank sand shall be furnished, placed, compacted complete in-place, either as bedding or backfill material, as shown on the plans, described in these specifications or as directed by the Engineer. After the trench or excavation has been brought to grade, the bank sand shall be placed and compacted as a bedding material, the construction item shall be placed and joined properly around and over that construction item as required and as shown on the plans, described in the specifications or directed by the Engineer. Bank sand shall be placed in layers not exceeding 8-inches. It shall be compacted with mechanical vibratory tamps to maximum dry density in accordance with ASTM Method D698 at a moisture content ranging from optimum to three percentage points above optimum. Water flooding will not be permitted.

3.2 TESTING

A. The Testing Laboratory's representative will determine the moisture density relationship for each material proposed for use as backfill, in accordance with ASTM Method D698. In place density will be determined in accordance with ASTM Methods D2922 or D1556, and with each type of construction. For walls and trenches, determine the in-place density for each 200 feet of wall or trench, for each lift of fill placed.

3.3 MEASUREMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

END OF SECTION 31 23 23.13

SECTION 31 23 23.16 - CEMENT STABILIZED SAND BEDDING AND BACKFILL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies cement stabilized sand to be used for backfilling and bedding as called for on the drawings, in other parts of the specifications, or as directed by the Engineer.

1.2 PERFORMANCE

A. The sand cement mixtures shall produce a minimum unconfined compressive strength of one hundred pounds per square inch (100 psi) in forty eight hours, when compacted to ninety five percent (95%) of Standard Proctor density (ASTM Method D558), without additional moisture control and when cured in plastic bags at a temperature of 73.4º F at plus or minus 3º F and tested in accordance with ASTM D1633.

B. Random samples of the delivered product will be taken in the field at the direction of the Engineer and tested at the Owners expense.

1.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cement shall be Type I Portland cement conforming to ASTM C150. Sand shall be clean durable sand containing not more than the following:
   1. Deleterious Materials:
      a. Clay lumps, when tested in accordance with ASTM C142 shall be less than 0.5 percent. Lightweight pieces, when tested in accordance with ASTM C123 shall be less than 5.0 percent. Organic impurities when tested in accordance with ASTM C40 shall not show a color darker than the standard color.
   2. The plasticity index shall be six (6) or less when tested in accordance with ASTM D4318.
   3. Sand shall be free of organic matter and deleterious substances and shall meet the following gradation requirement.

Square Sieve Size	% Passing, By Weight
3/8"	100%
No. 200	5 - 30%

   4. Water shall be clean and clear, free of oils, acids, alkalis, organic matter or other deleterious substances and shall conform to the requirements of ASTM C1602.

2.2 SAND-CEMENT MIXTURE PRODUCT

A. The mixture shall consist of not less than 1.5 sacks of Portland cement per cubic yard (1.1 sacks per ton) of material mixture as placed. The mixture shall contain sufficient water to hydrate the cement.

B. The cement, sand and water shall be mixed in a pug mill type mixer, which meets the approval of the Engineer. It shall be mixed for a minimum period of two minutes per batch.

PART 3 – EXECUTION

3.1 APPLICATION

A. The sand cement mixture shall be placed in maximum eight (8) inch thick lifts, loose measure, and thoroughly rodded and tamped around the pipe, boxes, structures, and paving sections. Placement and compaction shall be performed in a manner that will thoroughly fill all voids without placing undue strain on or displacement of the structure.

B. Cement stabilized sand backfill below the top of sewers, manholes, inlets or other structures shall be placed equally along all sides of the structure. Cement stabilized sand backfill/bedding shall be placed in a manner that will completely fill all voids in the trench. Should compaction be required to fill all voids in the areas described, hand operated tampers may be used.

C. Materials not placed and compacted within four (4) hours after mixing shall be rejected. Do not place or compact sand-cement mixtures in standing or free water.

D. Cement stabilized sand backfill/bedding that is placed in trench bottoms or all other locations between the tops of sewer lines to the bottom of the subgrade, shall be compacted to a minimum of ninety five percent (95%) of Standard Proctor Density (ASTM Method D558), and shall apply to all areas of construction within the limits of the project.

E. In-place density tests shall be taken at each location, each day, to test the placement of bedding/backfill material as directed by the Engineer. In-place densities shall be determined in accordance with ASTM D6938 or ASTM D1556.

END OF SECTION 31 23 23.16

SECTION 31 31 16 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Furnishing and applying both pre-construction and post-construction subterranean termite control treatment as described herein on the Project.

1.3 COORDINATION

A. Each offeror shall be responsible for determining during the proposal period the extent that any addenda issued during the proposal period may affect this Section of the Specifications.

B. Reference instructions to offerors for requirements regarding substitutions of materials and products.

C. Where conflicts occur between the Drawings and Specifications, between different drawings, between portions of this Section of the Specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

D. Contractor shall notify Structural Pest Control Board (SPCB) prior to application of termite treatment at the site as required by law.

E. Comply with all federal, state, and local requirements and authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Applicator shall be bonded and licensed with all applicable authorities.

B. Products and application techniques shall meet all requirements of federal, state, and local regulations regardless of products and techniques specified herein.

1.5 SUBMITTALS

A. Product Data:
   1. Manufacturer’s printed literature describing products and detailed application requirements.
      a. Document that product is currently allowed by the Environmental Protection Agency (EPA), the State of Texas, and all applicable county and local authorities for use under building slabs.
   2. Material Safety Data Sheet (MSDS).

B. Samples:
      a. Of proposed written warranty.

C. Certification:
   1. After the completion of Work under this Section, submit as part of the Close Out Documents, manufacturer's affidavit from the the Pest control Company staing that "The building has received a complete treatment for the prevention of subterranean termites, and that treatment is in accordance with rules and laws established by the Florida Department of Agriculture and Consumer Services."
   2. After completion of Work under this Section, submit manufacturer’s signed affidavit, verifying specification compliance of the chemicals, their proportions, and application.
   3. Contractor shall certify that pesticide used on project does not contain the chemical or have any ingredient known as “Dursban”.

1.6 WARRANTY

A. Provide written warranty against defects in materials and application for a period of five (5) years after application.

B. Defects shall include, but not be limited to the following:
   1. Evidence of activity by subterranean type termites.
   2. Damage of building materials due to subterranean termites.

C. During the warranty period the applicator shall, at his own expense provide additional termite treatment as required to prevent termite activity. Repair or replace building materials damaged by subterranean termite activity during the warranty period at no expense to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Termidor 80 WG Termitcide/Insecticide (EPA Reg. No. 7969-209) as manufactured by BASF Corporation, Florham Park, NJ; (973) 245-6000 or comparable product approved by Architect with minimum five (5) years of experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions in order to be considered.

2.2 MATERIALS

A. Dry powder containing 80% active ingredient and is conveniently package in water-soluble packages (paks).

B. Finished dilution: 0.125%.

C. Marking Dye to be included with termite chemicals.
   1. Basis of Design: Spray Pattern Indicator as manufactured by Mystic HC.

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspect building earth fill and foundation excavation for readiness and to ensure that soils are not too wet for proper application of treatment.

B. Post conspicuous warning signs indicating date(s) and time(s) of application and notify contractors working in area of such date(s) and time(s).

3.2 MIXING

A. Mixing shall be in accordance with manufacturer’s printed instructions.

3.3 APPLICATION

A. Do not apply while school is in session.

B. Apply to ensure a continuous chemical barrier.

C. Pre-Construction Treatment:
   1. Apply an overall treatment to the entire surface of soil or other substrate to be covered by the slab, including areas to be under carports, porches, basement floor, and entrance platforms in accordance with manufacturer’s printed instructions and recommended application rates.
   2. Apply along inside of foundation walls, and around plumbing, bath traps, utility services, and other features that penetrate the slab in accordance with manufacturer’s printed instructions and recommended application rates.
   3. Apply at crawl spaces, at hollow block foundations or voids in masonry resting on the footing, and at plenums in accordance with manufacturer’s printed instructions and recommended application rates.

D. Post-Construction Treatment:
   1. Apply a treatment under the slab, including attached porches, carports, entrance platforms, garages and similar slab structures in accordance with manufacturer’s printed instructions and recommended application rates. Drill all holes spaced in a manner to allow for application of a continuous chemical barrier. Plug and fill all drill holes in occupied areas or where visually exposed with a suitable sealant recommended by manufacturer.

2. Apply at existing cracks and cold, construction and expansion joints and around bath traps, plumbing and utility services which penetrate the slab in accordance with manufacturer's printed instructions and recommended application rates.
3. Apply at crawl spaces in accordance with manufacturer's printed instructions and recommended application rates.
4. At perimeter grade beams, trench along beams or use rodding as recommended by the manufacturer. The final treatment of the exterior beam will be performed within 30 days of notification of completion of landscaping or one (1) year from the date of completion of construction.
5. Allow for drying after application, in accordance with manufacturer's instructions, before placing vapor barrier and beginning concrete placement or other construction activities.
6. All treatment applications must be in compliance with all federal, state, and local laws and regulations with regard to mixing, applying, and disposing of debris and waste.

END OF SECTION 31 31 16

SECTION 31 32 13.17 - CEMENT STABILIZED SUBGRADE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

A. This item shall consist of treating the subgrade by the pulverizing, the addition of Portland cement, mixing, wetting and compacting the mixed material to the required density. This item applies to natural ground, embankment or existing pavement structure and shall be constructed as specified herein and in conformity to the typical sections, lines and grades as shown, on the plans or as established by the Engineer.

B. Cement treatment shall not be mixed or placed when the air temperature is below 40° F and falling, but may be mixed or placed when the air temperature is above 35° F and is rising, the temperature being taken in the shade and away from artificial heat and with the further provision that cement treatment shall be mixed or placed only when weather conditions, in the opinion of the Engineer, are suitable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Soil shall consist of approved material free from vegetation or other objectionable matter encountered in the existing roadbed and other acceptable material used in the preparation of the roadbed in accordance with this specification.

B. Portland cement shall be Type I of a standard brand of cement and shall conform to the requirements of ASTM Designation C150.

One sack, containing 1 cubic foot of cement, shall be considered as weighing 94 pounds net. One barrel of cement shall be considered as weighing 376 pounds net and containing 4 cubic feet.

The Contractor, at his option, may use bulk cement, provided the apparatus for handling, weighing and spreading the cement is approved by the Engineer. Cement weighing equipment shall meet the requirements of the Item, "Weighing and Measuring Equipment".

C. Water shall be free from substances deleterious to the hardening of the cement treatment and shall meet the requirements of the Item, Concrete Pavement.

The ratio of cement to soil will be based on dry material weight and shall be established by the Engineer in the field to provide the desired stability. The normal range is 6-percent to 10-percent by weight. The percentage of moisture in the soil, at the time of the cement application shall not exceed the quantity that will permit the uniform and intimate mixture of soil and cement during the dry mixing operations and shall not exceed the specified optimum moisture content for the soil cement mixture, as determined by ASTM Method D558.

2.2 EQUIPMENT

A. Equipment necessary for proper construction of the work shall be on the project, in first-class working condition and be approved by the Engineer, both as to type and condition, prior to the start

of construction operations. The Contractor shall at all times provide sufficient equipment to enable continuous prosecution of the work.

B. Portland cement treatment for materials in-place may be constructed with any machine or combination of machines and auxiliary equipment that will produce the results as outlined in this specification.

C. Mixing may be accomplished by a multiple-pass traveling mixing plant or a single-pass traveling mixing plant.

D. The equipment provided by the Contractor shall be operated by experienced and capable workmen and shall be that necessary to provide a cement treatment meeting the requirements herein specified.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. It is the primary requirement of this specification to secure a completed course of treated material containing a uniform Portland cement mixture free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to process a sufficient quantity of material to provide full depth as shown on the plans, to use the proper amount of Portland cement, maintain the work and rework the courses as necessary to meet the above requirements.

B. The Portland cement shall be mixed to the full depth shown on the plans and in no case, shall it be less than six (6) inches.

C. The subgrade shall be firm and able to support, without displacement, the construction equipment at the density hereinafter specified. Soft or yielding subgrade shall be corrected and made stable by scarifying and aeration or adding cement and compacting until it is of uniform stability.

D. Before other construction operations are begun, the subgrade shall be graded, shaped and compacted, as required, to construct the Portland cement treatment for materials in-place in conformance with the lines, grades, thickness and typical cross section shown on the plans. Unsuitable soil or material shall be removed and replaced with acceptable material.

E. The soil shall be so pulverized that, at the completion of moist-mixing 100-percent by dry weight passes a 1-inch sieve, and a minimum of 80-percent passes a No. 4 sieve, exclusive of gravel or stone retained on these sieves. Old bituminous wearing surfaces shall be pulverized so that 100 percent will pass a 2-inch sieve.

F. Portland cement shall be spread uniformly on the soil at the rate specified or as approved by the Engineer. If a bulk cement spread is used, it shall be positioned by string lines or other approved methods during spreading to insure a uniform distribution of cement.

G. Cement shall be applied only to such an area that all operations can be continuous and completed in daylight and within 5 hours of such application.

H. The percentage of moisture in the soil at the time of cement application, shall not exceed the quantity that will permit uniform and intimate mixture of the soil and cement during dry mixing operations, and it shall not exceed the specified optimum moisture content for the soil cement mixture.

I. No equipment, except that used in spreading and mixing, will be allowed to pass over the freshly spread cement, until it is mixed with the soil.

J. After the cement has been applied, it shall be dry mixed with the soil. Mixing shall continue until the cement has been sufficiently blended with the soil to prevent the formation of cement balls when water is applied. Any mixture of soil and cement that has not been compacted and finished shall not remain undisturbed for more than 30 minutes.

K. Immediately after dry mixing of soil and cement is complete, water as necessary shall be uniformly applied and incorporated into the mixture. Pressurized equipment shall provide an adequate supply to ensure continuous application of the required amount of water to the sections being processed within 3-hours of the application of the cement. Proper care shall be exercised to insure proper moisture distribution at all times. After the last increment of water has been added, mixing shall continue until a thorough and uniform mix has been obtained.

L. The material shall be compacted to not less than 95-percent of standard proctor density (ASTM Method D698). At the start of compaction, the percentage of moisture in the mixture and in the un-pulverized soil lumps, based on dry weights, shall not be below or more than two percentage points above the specified optimum moisture content and shall be less than that quantity which will cause the soil cement mixture to become unstable during compaction and finishing. When the uncompacted soil cement mixture is wetted by rain so that the average moisture content exceeds the tolerance given at the time of final compaction, the entire section shall be reconstructed in accordance with this specification at the sole expense of the Contractor.

M. The specified optimum moisture content and field density shall be determined from representative samples of the soil, taken in the fields and blended cement in a materials laboratory setting in accordance with ASTM Method D698.

N. Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth. The loose mixture shall then be uniformly compacted to the specified density lines and grades.

O. After the soil and cement mixture is compacted, water shall be uniformly applied, as needed, and thoroughly mixed. The surface shall then be reshaped to the required lines, grades and cross section and then lightly scarified to loosen any imprint left by compacting or shaping equipment.

P. The resulting surface shall be thoroughly rolled with a pneumatic tire roller and "skinned" by a power grader to achieve final grade, removing all loosened soil and cement from the section. The surface shall then be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. If aggregate larger than a No. 4 screen is present in the mixture, one complete coverage of the section with the flat wheel roller shall be made immediately after the skinning operation. When directed by the Engineer, surface finishing methods may be varied from this procedure, provided a dense uniform surface, free of surface compaction planes, is produced. The moisture content of the surface material must be maintained at its specified optimum during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than 2-hours, a smooth, closely knit surface, free of cracks, ridges or loose material conforming to the crown, grade and line shown on the plans.

3.2 CURING

A. After the cement treated course has been finished as specified herein, the surface shall be protected against rapid drying by either of the following curing methods for a minimum period of 3-days, or as directed by the Engineer. These methods of curing are:
   1. Maintain in a thorough and continuously moist condition by sprinkling.
   2. Apply an asphalt membrane to the treated course, immediately after its completion. The material for the asphalt membrane shall be MC-30. The asphaltic material shall meet the

requirements of Item 300, "Asphalt Oils and Emulsions" contained in the Texas Highway Department; "Standard Specifications for Construction of Highways, Streets and Bridges," Latest Edition. The quantity and type of asphalt approved for use by the Engineer shall be sufficient to completely cover and seal the total surface of the base and fill all voids. If the Contractor elects to use this method, it shall be his responsibility to protect the asphalt membrane from being picked up by the traffic. The asphalt membrane may remain in-place when the proposed surface or base courses are placed. The surface or other base courses may be applied on the finished base as soon after completion as operations will permit.

3.3 CONSTRUCTION JOINTS

A. At the end of each day's construction a straight transverse construction joint shall be formed by cutting back into the total width of completed work to form a true two-inch depth vertical face free of loose and shattered material.

B. Cement treatment for large wide areas shall be built in a series of parallel lanes of convenient length and width meeting the approval of the Engineer.

3.4 TRAFFIC

A. After the 3 day curing period, or as directed by the Engineer, completed sections of cement treated material in-place, may be opened immediately to local traffic and to construction equipment and to all traffic after the curing period, provided the cement treated course has hardened sufficiently to prevent marring or distorting the surface by equipment or traffic.

3.5 MAINTENANCE

A. The Contractor shall be required, within the limits of his contract, to maintain the cement treated course in good condition until all work has been completed and accepted. Maintenance shall include immediate repairs to any defects that may occur. This work shall be done by the Contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. Faulty work shall be replaced for the full depth at treatment. It is the intent of this specification that the Contractor construct the plan depth of cement treatment in one homogenous mass. The addition of thin stabilized layers will not be permitted in order to provide the minimum specified depth.

3.6 QUALITY ASSURANCE

A. The Testing Laboratory’s representative will determine the Moisture-Density Relationships in accordance with ASTM Method D698 on material secured from the roadway. Samples will be blended with Portland cement for each type of material encountered.

B. The Testing Laboratory’ representative will determine the in-place density in accordance with ASTM Methods D2922 or D1556. The minimum level of testing will consist of at least three tests for each 1,000 feet per lane of roadway or 4,000 square feet (500 square yards) of embankment.

3.7 MEASUREMENT

A. The work performed and the material furnished as prescribed by this item will be measured as follows:
   1. Manipulation of cement during stabilization of the subgrade will be measured by the square yard of surface area of the completed and accepted work in-place.
   2. Portland cement will be measured by the ton of 2,000 pounds.

END OF SECTION 31 23 13.17

SECTION 31 32 13.19 - LIME STABILIZED SUBGRADE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This item shall consist of treating the subgrade, by the pulverizing, addition of lime, mixing and compacting the mixed material to the required depth and density, and in the amounts shown on the plans.

B. This item applies to natural ground, embankment, base or sub-base and shall be constructed to the sections, lines and grades shown on the plans. The subgrade shall be stabilized with lime to a depth of at least 6-inches in the amount recommended by a materials engineering laboratory. The P.I. shall be determined by ASTM Method D4318.

1.2 QUALITY ASSURANCE

A. The Testing Laboratory's representative will determine the Moisture-Density Relationships in accordance with ASTM Method D698 on material secured from the roadway after stabilization with lime, for each type of material encountered.

B. The Testing Laboratory's representative will determine the in-place density in accordance with ASTM Method D2922 or D1556. The minimum level of testing will consist of at least three tests for each 1,000 feet per lane of roadway or 4,000 square feet (500 square yards) of embankment.

1.3 MEASUREMENT

A. Manipulation of lime during the stabilization of the subgrade shall be measured by the square yard of subgrade actually stabilized. Lime shall be measured as follows:
   1. Type A - Hydrated lime shall be measured by the ton of 2,000 pounds, dry weight.
   2. Type B - Commercial lime slurry shall be measured by the ton of 2,000 pounds of lime "dry solids", in the slurry. The quantity of lime shall be calculated from the minimum percentage of solids for:
      a. Grade 2: At least 35 percent by weight of slurry and calculate the quantity of lime by the ton of 2,000 pounds, based on 35 percent lime content.

1.4 PAYMENT

A. Payment for manipulation of "Lime Stabilized Subgrade" shall be made at the contract unit price per square yard of compacted subgrade for the depth specified.

B. The unit price bid shall be full compensation for loosening, mixing, pulverizing, spreading, drying, application of lime, water content of the slurry, compaction, shaping and maintaining for all manipulations required, for all hauling and freight involved, for all tools, equipment, labor and all incidentals necessary to complete the work.

C. Payment for "Lime" shall be made at the contract unit price per ton of lime used for stabilizing the subgrade.

PART 2 – GENERAL

2.1 MATERIALS

A. Lime for stabilization shall be classified as Type A- Hydrated Lime, or Type B- Commercial Lime Slurry, conforming to the requirements of Section 31 32 13.20 - Hydrated Lime and Lime Slurry.

2.2 EQUIPMENT

A. The machinery, tools and equipment necessary for proper execution of the work shall be on the project and approved by the Engineer prior to the beginning of construction operations. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. It is the primary requirement of this specification to secure a completed course of treated material containing a uniform lime soil mixture free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.

B. The subgrade shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the Engineer. The subgrade shall be firm and able to support, without displacement, the construction equipment at the density herein specified. Any wet or unstable materials below the secondary grade shall be corrected, as directed by the Engineer, by scarifying, adding lime, and compacting, or other methods until satisfactory stability is obtained. The cost of the repair of the secondary subgrade and any materials below the secondary subgrade is incidental to this Section.

C. The Contractor shall be required to proof-roll the subgrade, as directed by the Engineer, before using the pulverizing machine and correct any soft areas that this rolling may reveal.

D. Lime shall be spread only on that area where the first mixing operations can be completed during the same working day. The application and mixing of lime with the material shall be accomplished by the methods hereinafter described as "Dry Placing" or "Slurry Placing". When Type A, Hydrated Lime, is specified, the Contractor may use either method, unless otherwise noted on the plans.

E. When dry placing, the lime shall be spread by an approved spreader or by bag distribution at the rates shown on the Bid Sheet, or as directed by the Engineer.

F. The lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime by wind to a minimum. Lime shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread the lime.

G. The material shall be sprinkled as directed by the Engineer, until the proper moisture content has been secured. Where Type A, hydrated lime is specified and slurry placement is used, the Type A hydrate shall be mixed with water to form a slurry of the solids content designated by the Engineer. A minimum of two mixing passes will be required.

H. Where Type B, commercial lime slurry is to be used, it shall be of the minimum solids and purity for the applicable grade being used. The distribution of lime shall be at the rates shown on the proposal

form, or as directed by the Engineer. Proper application shall be attained by successive passes over a measured section of the roadway, until the proper moisture and lime content has been secured. The distributor truck shall be equipped with an agitator, which will keep the lime and water in a uniform mixture.

I. The material and lime shall be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until, in the opinion of the Engineer, a homogenous friable mixture of material and lime is obtained, such that when all non-slaking aggregates retained on the 3/4-inch sieve are removed, the remainder of the material shall meet the following requirements when tested in accordance with ASTM Method C136, from samples procured from the roadway.

TABLE I

Minimum Passing 1 3/4" sieve	100 Percent
Minimum Passing 3/4" sieve	85 Percent

J. If gradation is achieved on the first mixing, no additional mixing is required.

K. The soil lime mixture shall be sprinkled during the mixing operation as directed by the Engineer to provide optimum moisture in the mixing. The subgrade shall be stabilized to a minimum depth of 6-inches and compacted to a minimum of 95-percent of standard proctor density (ASTM D698) at a moisture content of optimum to 3-percent above optimum.

L. During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6-hours, or more, or has had excessive loss due to washing or blowing will not be accepted for payment.

M. Compaction of the mixture shall begin immediately after final mixing unless approval has been obtained from the Engineer not to do so. The material shall be aerated and/or sprinkled as necessary, to provide the optimum moisture content. Compaction shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted.

N. The material and lime shall be thoroughly mixed by approved road mixers or other approved equipment and the mixing continued until, in the opinion of the Engineer, a homogenous, friable mixture of material and lime is obtained, free from all clods or lumps. Materials containing plastic clays or other materials which will not readily mix with lime shall be mixed as thoroughly as possible at the time of lime application, brought up to the proper moisture content and left to cure 48 to 96, hours as directed by the Engineer. During the curing period the material shall be kept moist as directed.

O. If a second mixing is required, the material shall be given a final mixing, using approved methods. If the soil binder-lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying, or the use of other approved pulverization methods, so that all non-slaking material retained on the 3/4-inch sieve is removed and the remainder of the material shall meet the gradation requirements outlined by Table I. After the second mixing has been completed, the material shall be allowed to cure for a minimum of 3 days, unless otherwise directed by the Engineer.

P. The material shall be sprinkled and rolled, as directed by the Engineer. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required and reshaping and re-compacting by sprinkling and rolling. The surface of the course shall be maintained and cured for a minimum of three (3) days, prior to placing a base or surface course or until traffic is allowed to travel thereon.

Q. In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary will be made by the Engineer. If

the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation, the shape of the course shall be maintained by blading and the surface upon completion shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density and finish before the next course is placed or the work is accepted, it shall be reprocessed and refinished at the expense of the Contractor.

3.2 FINISHING

A. After the final course of the lime treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling as directed with a pneumatic tire or other suitable roller sufficiently light to prevent hair cracking. The completed section shall be moist or emulsion cured until covered by base material, unless otherwise directed by the Engineer. If the plans provide for the treated material to be sealed or covered by other courses of material, such seal or course shall be applied within 14 days after final mixing and compaction is completed, unless otherwise directed by the Engineer.

END OF SECTION 31 32 13.19

SECTION 31 32 13.20 - HYDRATED LIME AND LIME SLURRY

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section establishes the requirements for hydrated lime and commercial lime slurry of the type and grade considered suitable for use in the treatment of natural or processed materials or mixtures for subgrade, sub-base and base construction.

1.2 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The various types and grades are defined and identified as follows:

1. Type A, Hydrated Lime: Shall consist of a dry powder obtained by treating quicklime with enough water to satisfy its chemical affinity for water under the conditions of its hydration. This material is to consist essentially of calcium hydroxide or a mixture of calcium hydroxide and a small allowable percentage of calcium oxide, magnesium oxide and magnesium hydroxide. Hydrated lime shall meet the requirements of ASTM Designation.
   a. When sampled and tested according to prescribed Texas Highway Department procedures, hydrated lime shall conform to the following requirements as to chemical composition:
      1) Hydrate alkalinity, percent by weight CA (OH)2 Min. 90.0%
      2) Unhydrated lime content, percent by weight CaO Max. 5.0%
      3) "Free Water" content, percent by weight H 2 0 Max. 4.0%

   b. The percent by weight of residue retained shall conform to the following requirements:
      1) Residue retained on a No. 6 sieve Max. 0.0%
      2) Residue retained on a No. 10 sieve Max. 1.0%
      3) Residue retained on a No. 30 sieve Max. 2.5%

   c. Specifications for Type "A" applies specifically to the normal hydrate of lime made from "high-calcium" type limestone. Hydrated Lime for stabilization purposes shall be applied, as provided in the governing specifications, as a dry powder or mixed with water to form a slurry.

2. Type B, Commercial Lime Slurry: Shall be pumpable suspension of solids in water. The water or liquid portion of the slurry shall not contain dissolved material in sufficient quantity and/or nature injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of "solids content", shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following requirements as to chemical composition, residue and delivered in trucks which shall be equipped with an agitator which will keep the lime and water in a uniform mixture.

a. Chemical Composition: The "solids content" of the lime slurry shall have a hydrate alkalinity Ca (OH)2 of not less than 90% by weight.
b. Residue: The percent by weight of residue retained in the "solids content" of lime slurry shall conform to the following requirements:
   1) Residue retained on a No. 6 sieve Max. 0.0%
   2) Residue retained on a No. 10 sieve Max. 1.0%
   3) Residue retained on a No. 30 sieve Max. 2.5%

c. Type B: Commercial Lime Slurry shall conform to one of the following grades:
   1) Grade 1: The "Dry Solids Contents", shall be at least 31 percent by weight of the slurry.
   2) Grade 2: The "Dry Solids Contents", shall be at least 35 percent by weight of the slurry.
   3) Grade 3: The "Dry Solids Contents", shall be at least 46 percent by weight.

PART 3 – EXECUTION

3.1 SAMPLING AND TESTING

A. The sampling and testing of lime slurry shall be as determined by Test Method Tex-600-J, "Lime Testing Procedure".
   1. When Type A: Hydrated Lime is used, the quantity of lime will be measured by the ton of 2000 pounds, dry weight.
   2. When Type B: Commercial Lime slurry, is used, the quantity of lime shall be calculated from the required minimum percent solids based upon the use of Grade 1, Grade 2, or Grade 3 as follows:
      a. Grade 1: The "Dry Solids Content" shall be at least 31 percent by weight of the slurry and the quantity of lime will be calculated by the ton of 2000 pounds based on the 31 percent dry weight solids.
      b. Grade 2: The "Dry Solids Content" shall be at least 35 percent by weight of the slurry and the quantity of lime will be calculated by the ton of 2000 pounds based on the 35 percent dry weight solids.
      c. Grade 3: The "Dry Solids Content" shall be at least 46 percent by weight of the slurry and the quantity of lime will be calculated by the ton of 2,000 pounds based on the 46 percent dry weight solids.

END OF SECTION 31 32 13.20

SECTION 31 32 13.21 - LIME-FLYASH STABILIZED SUBGRADE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This item shall consist of treating the subgrade by the pulverizing, addition of lime flyash and/or flyash, mixing and compacting the mixed material to the required density. This item applies to natural ground and embankment and shall be constructed as specified herein and in conformity with the typical sections, lines and grades shown on the Plans.

1.2 QUALITY ASSURANCE

A. The Materials Engineer will determine the Moisture-Density Relationship in accordance with ASTM Method D698, on material secured from the roadway. Samples shall be blended with Lime-Flyash in the laboratory for each type of material encountered.

B. The Materials Engineer will determine the in-place density in accordance with ASTM Method D2922 or D1556. The minimum level of testing will consist of at least three tests of 4,000 square feet (500 square yards) of subgrade.

1.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Hydrated lime shall meet the requirements of ASTM C977 and SECTION 31 32 13.20 – HYDRATED LIME AND LIME SLURRY of these Specifications. When Type B, commercial lime slurry, is specified, the Contractor shall select, prior to construction, the grade to be used and shall notify the Engineer in writing before changing from one grade to another.

B. Flyash shall meet the requirements of ASTM C618, Class C. Flyash shall also have a minimum CaO content of 20 percent.

C. Water shall meet the requirements of ASTM Designation C94.

2.2 EQUIPMENT

A. Machinery, tools and equipment for proper performance of the work shall be on the Project and approved by the Engineer prior to the beginning of construction operations.

B. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

C. Hydrated lime and flyash shall be stored and handled in closed, weatherproof containers until immediately before distribution on the subgrade. If storage bins are used, they shall be completely enclosed. Materials in bags shall be stored in weatherproof buildings with adequate protection

from ground dampness.

D. If lime and/or flyash are furnished in trucks, each truck shall have a weight ticket from a certified scale.

E. If lime and/or flyash are furnished in bags, each bag shall bear the manufacturer's certified weight. Bags varying more than five percent from that weight may be rejected and the average weight of the bags in any shipment, as shown by weighing 50 bags taken at random, shall not be less than the manufacturer's certified weight.

PART 3 – PRODUCTS

3.1 CONSTRUCTION METHODS

A. It is the primary requirement of this Specification to secure a complete course of treated material containing a uniform lime-flyash or flyash mixture free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface and suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime and flyash, maintain the work and rework the courses as necessary to meet the above requirements.

B. Before other operations are begun, the subgrade shall be graded, shaped, and compacted as required to construct the lime-flyash or flyash treatment for materials in-place in conformance with the lines, grades, thickness and typical cross sections shown on the Plans. Unsuitable soil or material shall be removed and replaced with acceptable material.

C. The subgrade shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the Engineer. The subgrade shall be firm and able to support, without displacement, the construction equipment at the density herein specified. Any wet or unstable materials below the secondary grade shall be corrected, as directed by the Engineer, by scarifying, adding lime and/or fly ash, and compacting, or other methods until satisfactory stability is obtained. The cost of the repair of the secondary subgrade and any materials below the secondary subgrade is incidental to this Section.

D. The Contractor shall be required to proof-roll the subgrade, as directed by the Engineer, before using the pulverizing machine and correct any soft areas that this rolling may reveal.

E. The Contractor shall be required to use a cutting and pulverizing machine that will remove the subgrade material accurately to the secondary subgrade; and pulverize the material at the same time. He will not be required to expose the secondary grade nor windrow the material. However, the Contractor shall be required to roll the subgrade, before using the pulverizing machine and correct any soft areas that this rolling may reveal. This method will be permitted only where a machine is provided which will ensure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a smooth surface over the entire width of the cut.

F. The cost of the repair of the secondary subgrade and any materials below the secondary subgrade is incidental to this item.

G. When lime-flyash stabilization is required it shall be a two-phase operation, with the lime placed and allowed to cure, before the flyash stabilization begins.

H. Application of the lime and the subsequent curing shall be in accordance with SECTION 31 32 13.19 - LIME STABILIZED SUBGRADE. After the subgrade has cured for the time required by that Specification, then flyash stabilization may begin. Flyash stabilization shall be in accordance with this Specification. Unless otherwise noted, the thickness of stabilization shall be 6-inches.

I. The machine will be of such design that a visible indication is given at all times that the machine is cutting to the proper depth.

J. Lime shall be spread only on that area where the first mixing operation can be completed during the same working day.

K. The sequence of application of lime and flyash, with the material, shall be accomplished by the methods hereinafter described as "Dry Placing", or "Slurry Placing". When Type A, hydrated lime is specified, the Contractor may use either method.

L. The lime or flyash shall be spread by a spreader or by bag distribution at the rate directed by the Engineer.

M. For dry placing, the lime or flyash shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime or flyash by wind to a minimum. Lime or flyash shall not be applied when wind conditions are such that blowing lime or flyash becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread the lime or flyash.

N. The materials shall be sprinkled until the proper moisture content has been secured. However, initial mixing after the addition of lime or flyash will be accomplished dry or with a minimum of water to prevent lime and/or flyash balls.

O. For slurry placing, the lime or flyash shall be mixed with water in vehicles with approved distributors and applied as a thin water suspension or slurry.

P. Type B, commercial lime slurry, shall be applied with a lime percentage not less than that applicable for the grade used. The distribution of lime and flyash shall be attained by successive passes over a measured section of roadway until the proper moisture and lime or flyash content has been secured. The distributor vehicle shall be equipped with an agitator, which will keep the lime or flyash and water in a uniform mixture.

Q. The mixing procedure shall be the same for "Dry Placing or "Slurry Placing", as hereinafter described.

R. The material shall be uniformly mixed by approved methods. If the soil binder lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying or the use of other approved pulverization methods so that when all non-slaking aggregates retained on the 3/4" sieve are removed, the remainder of the material shall meet the following requirements when tested at the field moisture condition, or dry by laboratory sieves in accordance with ASTM Method C136.

Minimum Passing 1-3/4 sieve	100 percent
Minimum Passing 3/4 sieve	85 percent

S. It is the intent of this Specification that lime and flyash shall be spread as directed by the Engineer.

T. The amount of lime and flyash used shall be as directed by the Engineer.

U. During the interval of time between application and mixing, hydrated lime or flyash that has been exposed to excessive loss due to washing or blowing will not be accepted for payment. Spreading, mixing, compaction and finishing for lime-flyash stabilized subgrade should be completed during daylight hours of the same day.

V. If flyash only is to be used without lime, the following mixing procedures shall apply.

W. The raw material shall be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until a homogeneous, friable mixture is obtained, free from all clods or lumps.

X. The flyash shall be distributed at a uniform rate and in such manner as to reduce the scattering of flyash by the wind to a minimum. Flyash shall not be applied when wind conditions, are such that blowing flyash becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread flyash.

Y. The material and flyash shall be thoroughly mixed by approved road mixers or other approved equipment and the mixing continued until a homogeneous, friable mixture of materials is obtained, free from all clods or lumps. If the soil binder-flyash mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying or the use of other approved pulverization methods so that when all nonslaking aggregates, retained on the 3/4" sieve are removed, the remainder of the material shall meet the following requirements when tested at the field moisture condition or dry by laboratory sieves using ASTM Method C136:

Minimum Passing 1-3/4 sieve	100 percent
Minimum Passing 3/4 sieve	85 percent

Z. Flyash shall be applied only to such an area that all the operations can be continuous and completed in daylight.

AA. During the interval of time between application and mixing, flyash that has been exposed to the open air for a period of 6 hours or more, or to excessive loss due to washing or blowing will not be accepted for payment. It is recommended that the mixing and compaction of flyash stabilized subgrade by completed within 2 hours in order to take advantage of rapid initial set characteristics.

BB. Mixing after the addition of flyash will be accomplished dry or with a minimum of water to prevent flyash balls.

CC. Compaction of the mixture shall begin immediately after adding and mixing of the last stabilizing agent and be completed within 6 hours. The material shall be aerated or sprinkled as necessary to provide the optimum moisture. Compaction shall begin at the bottom and shall continue until the entire depth of the mixture is uniformly compacted to 95 percent of standard proctor density (ASTM D698), to a minimum depth of 6 inches. In addition to the requirements it shall be compacted to the extent necessary to remain firm and stable under the construction equipment. Throughout the entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown of the Plans and to the established lines and grades.

DD. After the final layer of the lime-flyash or flyash treated subgrade has been compacted, it shall be brought up to the required lines and grades, and in accordance with the typical sections.

EE. The resulting surface shall be thoroughly rolled with a pneumatic tire roller and skinned by a power grader to achieve final grade, removing all loosened stabilized material from the section. The surface shall be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. If aggregate larger than a 3/4" screen is present in the mixture, one complete coverage of the section with the flat wheel roller shall be made immediately after the skinning operation. Surface finishing methods may be varied from this procedure to provide a dense, uniform surface, free of surface compaction planes. The moisture content of the surface material must be maintained at optimum during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than 2 hours, a smooth, closely knit surface, free of cracks, ridges or loose material conformity to the crown, grade and line shown on the Plans.

FF. After the lime-flyash or flyash treated course has been finished as specified herein, the surface shall be protected against rapid drying by either of the following curing methods for a period of not less than 3 days or as directed by the Engineer.
   1. Maintain in a thorough and continuously moist condition by sprinkling.
   2. Apply an asphalt membrane to the treated course, immediately after same is completed. The asphalt material for the membrane shall be MC-30. Asphaltic material shall meet the requirements of Item 300, Oils, Asphalts and Emulsions, of the TxDOT "Standard Specifications for Construction of Highways, Streets and Bridges". The asphalt shall completely cover and seal the total surface of the base and fill all voids. If the Contractor elects to use this method, it shall be his responsibility to protect the asphalt membrane from being picked up by traffic.

GG. The asphalt membrane may remain in place when the proposed surface or other base courses are applied.

HH. Completed sections of lime-flyash or flyash treated material in-place may be opened immediately to local traffic and to construction equipment and to all traffic after the curing period, provided the lime-flyash or flyash treated course has hardened sufficiently to prevent marring or distorting the surface by equipment or traffic, and after the minimum 3 day curing period. If the Plans provide for the treated material to be sealed or covered by other courses of material such seal or course shall be applied within 14 days after compaction unless otherwise directed by the Engineer. Should the material, due to any reason or cause, lose the required stability, density and finish before the next course is placed, it shall be reprocessed and refinished at the expense of the Contractor.

END OF SECTION 31 32 13.21

SECTION 31 41 00 - TRENCH SAFETY SYSTEM

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This item is for furnishing all labor and materials for installation and maintenance of a trench safety system.

B. For any trench excavation in materials other than solid rock, greater than five (5) feet in depth, or where shown on the plans, the contractor shall provide a trench safety system. This trench safety system shall be in accordance with the appropriate requirements established in the Occupational Safety and Health Administration (OSHA), Safety and Health Regulations, Part 1926, Subpart P - "Excavations, Trenching and Shoring" (latest edition).

1.2 MEASUREMENT

A. Measurement of the "Trench Safety System" for gravity pipelines and boxes and for pressure pipelines shall be made by the linear foot of trench measured along the centerline of the trench.

1.3 PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS
Not Used

PART 3 – EXECUTION
Not Used

END OF SECTION 31 41 00

SECTION 32 13 13 - CONCRETE PAVING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete paving, including, but not limited to, parking lots, aprons, sidewalks, curbs, handicapped accessible ramps, approaches, and miscellaneous exterior concrete shown on drawings.

B. Traffic lane and parking space paint striping, including, but not limited to, painting of curbs and stenciling of signs stipulating FIRE LANES, NO PARKING and BUS LOADING areas, crosswalks, handicapped accessible parking spaces, and other areas shown on drawings or required by authorities having jurisdiction.

C. Precast concrete wheel stops and accessories are shown in the drawings.

1.2 QUALITY ASSURANCE

A. Where standards or requirements of this Section are in conflict with those noted on the Contract Drawings, or the Building Code, the more stringent requirements shall govern. Bring all conflicts and discrepancies to the attention of the Architect and do not start work until such conflicts and discrepancies are clarified and corrected. Failure to do so will not relieve the Contractor from performing the Work correctly at no additional expense to the Owner.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)
   1. M-90
   2. M-213

B. American Concrete Institute (ACI)
   1. 305, Hot Weather Concreting
   2. 306, Cold Weather Concreting

C. ASTM International (ASTM)
   1. A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
   2. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   3. C33, Standard Specification for Concrete Aggregates
   4. C94, Standard Specification for Ready-Mixed Concrete
   5. C150, Standard Specification for Portland Cement
   6. C260, Standard Specification for Air-Entraining Admixtures for Concrete
   7. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
   8. C494, Standard Specification for Chemical Admixtures for Concrete
   9. C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
   10. C920, Standard Specification for Elastomeric Joint Sealants
   11. C979, Standard Specification for Pigments for Integrally Colored Concrete

D. Federal Specifications (FS)
   1. TT-S-00227E, Elastomeric Joint Sealants
   2. TT-P-1952B, Traffic and Airfield Marking Paint, Water Emulsion Base

1.5 PROJECT CONDITIONS

A. Do not place concrete in contact with frozen earth. Do not commence concrete placement unless the temperature is at least 35 degrees F and rising, or slabs until the temperature rises above 40 degrees F.

B. Discontinue concrete placement when air temperatures exceed 100 degrees F.

C. Dispose of any concrete that exceeds 95 degrees F as determined by the construction management personnel in the field.

D. Do not place concrete during rain.

E. Cold Weather Placing: Comply with ACI 306 to protect all concrete work from physical damage and reduce strength caused by frost, freezing actions, or low temperatures. Place no concrete against frozen earth.

F. Hot Weather Placing: Prepare aggregates, mix water and other ingredients, and place, cure, and protect concrete according to the requirements of ACI 305.

G. Do not apply traffic or zone marking paint on wet or damp surfaces or when rain is imminent. Do not commence painting operations until material, air, and/or surface temperature and dew point are within the paint manufacturer’s recommended application limits.

1.6 TESTS AND INSPECTIONS

A. Before starting any work under this section, make all required arrangements with the testing agency. Provide testing laboratory with certified reports on proposed cement, aggregates mixing water, and admixtures.

B. Lab shall review design mixes for each type of concrete using previously tested and approved materials.

C. The testing lab will proportion mixes by laboratory trial batch, using materials to be employed in the work for each class of concrete required and reporting to the Architect.
   1. Concrete Compression Test - 7-day and 28-day
   2. Concrete Slump Test
   3. Concrete Air Content

D. Furnish certified reports of the format shown herein of each proposed mix for each type of concrete at least 30 days prior to the start of installation of the Work of this Section.

E. Furnish ready mix delivery tickets to the field personnel upon request.

1.7 SUBMITTALS

A. Product Data: Manufacturer's descriptive literature for concrete admixtures.

B. Shop Drawings: Show locations and installation procedures. Include details of joints, accessories, reinforcement, and clearances. Include a concrete placement sequence schedule.

C. Concrete Design Mix Reports:
   1. One (1) for each type of concrete to be used.

D. Submit product data and shop drawings for ALL items to be installed.

E. Refer to Section 01 33 00 for submittal procedures.

1.8 INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination

B. Required Participants:
1. General Contractor Superintendent
2. Placement and Finishing Foreman
3. Concrete Supplier
4. Testing Lab

1.9 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2. 1 APPROVED MANUFACTURERS

A. Manufacturers named within this Section are approved for use on the Project for the product for which they are specified. Other manufacturers must have a minimum of five (5) years of experience manufacturing the product specified and meet or exceed the specifications for that product. Substitution of products must be in accordance with the General Conditions, Supplementary Conditions, and Section 01 33 00, Submittals to be considered prior to proposal.

2. 2 MATERIALS

A. Formwork:
1. General: Contractor may use any of the following formwork materials if material meets the following and will not stain, or impart any undesirable texture, i.e. wood grain, where such texture would be objectionable in an exposed location.
   a. Wood Forms:
      1) Plywood: PS 1, Douglas Fir or Spruce species.
      2) Medium Density Overlay (MDO): One (1) side grade; sound undamaged sheets with clean, true edges.
      3) Lumber: Southern Yellow Pine species; No. 2 grade, with grade stamp clearly visible.
   b. Prefabricated Forms:
      1) Preformed Steel Forms: Minimum 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
      2) Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Metal Reinforcement:
1. Bars:
   a. Conform to ACI 315, latest edition.
   b. Comply with ASTM A615, Grade 60, deformed billet steel bars, unfinished, except Number 3 bars shall comply with ASTM A615, Grade 40, deformed billet steel bars, unfinished.
2. Tie Wire: 16 gauge annealed.

C. Concrete Materials (Other than concrete for extruded curbs, unless noted otherwise)

1. Cement: Type 1, ASTM C150, unless approved otherwise by Architect. Use one (1) brand of cement for entire project.
2. Concrete Admixtures: Provide admixtures produced and serviced by established, reputable manufacturer and used in compliance with manufacturer's recommendations.
   a. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures. Provide one (1) of the following, or Architect approved equal:
      1) Eucon AEA-92 and Eucon Air Mix 200 by The Euclid Chemical Company.
      2) Sika AEA 14 by Sika Corp.
      3) MasterAir AE or MasterAir VR by BASF Admixtures.
   b. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.05 percent chloride ions. Provide one (1) of the following, or Architect approved equal:
      1) Eucon WR 75 or Eucon WR 91 by The Euclid Chemical Company.
      2) Master Pozzolith 322 by BASF Admixtures.
      3) Plastocrete 161 by Sika Corp.
   c. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or Type G and containing not more than 0.05 percent chloride ions. Provide one (1) of the following, or Architect approved equal:
      1) Eucon 37 by The Euclid Chemical Company.
      2) ViscoCrete by Sika Corp.
      3) Master Rheobuild 1000 by BASF Admixtures.
3. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.
4. Integral Color Pigment (Required for new concrete handicapped accessibility ramps): Mineral oxide, lightfast, lime-proof, water-resistant type conforming to ASTM C979. Color(s) shall be as selected by Architect from manufacturer’s standard color line. Provide one (1) of the following, or Architect approved equal:
   a. ChemSystems, Inc.
   b. Davis Colors
   c. New Riverside Ochre Co., Inc.
   d. Scofield Decorative Concrete by Sika Corp.
5. Color Stain (Required for existing concrete handicapped accessibility ramps): A penetrating acrylic concrete stain, designed for adding color to existing concrete. Color(s) shall be as selected by Architect from manufacturer’s standard color line. Provide H & C Silicone Acrylic Concrete Stain manufactured by Sherwin Williams, or Architect approved equal.
6. Aggregates:
   a. Comply with ASTM C33
   b. Maximum size not larger than 1/5 of narrowest dimension between forms of the member for which concrete is to be used. Not larger than 3/4 of minimum clear spacing between reinforcing bars.
   c. 1-1/2 inch maximum in paving slabs.
7. Strengths:
   a. Five and a half (5.5) sack (shall contain no less than 5.5 sacks of Portland cement)/3,500 psi/28 days.
   b. Strength recommendations on Drawings supersede when they are greater than specified here.
8. Water: Drinking quality.
9. Water - Cement Ratio (lb water per lb of Portland cement):
   1) 0.52 Maximum
10. Slump:
    a. Slump shall be 4 inches plus or minus 1 inch, unless specifically noted otherwise.

D. Joints:
   1. Construction Joints and Expansion Joints: Refer to Paragraph on Accessories below.

2. Tooled Control Joint: Scored ¼-inch wide x 1/4 thickness of concrete in depth.

E. Accessories:
1. Chairs and Spacers: Heavy-duty plastic-type sized to support all reinforcing steel to proper height directly on properly prepared and compacted subgrade. No sand cushion pads will be permitted. Provide chairs and spacers Series "B" by W.H.C. Products, Inc., E-Z Chair by Dayton Superior, MEDCO PC-4 by Meadow Burke, a CHR Company, GTI Bar Chair by General Technologies, Inc., or approved equivalent. Maximum spacing of chairs shall be 36-inches on center each way.
2. Form Release Agent: Colorless mineral oil which will not stain concrete or absorb moisture.
3. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages, Fasteners: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
4. Epoxy Adhesive: ASTM C881, two (2) component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces. Provide one (1) of the following, or approved equal:
   a. Euco #452 Epoxy System or Euco #620 Epoxy System by The Euclid Chemical Company.
   b. Sikadur Hi-Mod by Sika Corp.
5. Expansion Joints:
   a. Fiber Joint Filler: Pre-molded asphalt impregnated rigid fiber board. Comply with AASHTO M-213. Use 3/4-inch-thick at expansion joints adjacent to extruded curbs, 1/2-inch-thick at perimeter of footings for ground-set items such as bollards and fence posts where such footings are incorporated into slabs; elsewhere as shown.
   b. Wood Expansion Joints: Where indicated in the drawing provide construction clear heart grade redwood joints conforming to AASHTO M-90. Provide sizes indicated on drawings. Do not install adjacent to curbs.
   c. Joint Sealant: Shall be a self-leveling silicone base, cold-applied joint sealing compound complying with DOWSIL 890-SL Silicone Joint Sealant as manufactured by Dow Silicones Corporation or approved equal.
   Joint sealant must have a minimum 5-year warranty.
6. Load Transfer Units:
   a. Light Duty (sidewalk): 3/4 inch thick clear heart redwood expansion joint form with minimum one (1) inch deep removable top strip, 1/2 inch x 10 inch smooth steel reinforcing bars at 12 inches on center +/- with bond breaker sleeve on one (1) side, and 3/32 inch thick steel bar-support plates each side. Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.
   b. Medium Duty (Auto) / Heavy Duty (truck/bus traffic): 3/4 inch thick redwood expansion joint form with minimum one (1) inch deep removable top strip, 3/4 inch by 18 inch steel reinforcing bars at 12 inches on center+/- with bond-breaker sleeve on one (1) side and 3/16 inch steel bar-support plates each side. Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.

F. Curing Compound: The compound shall conform to ASTM C309-1315, Type II (A.I.M. Regulations - VOC Compliant). Provide 1600 White by W. R. Meadows, Inc., or equal products by BASF Admixtures, Dayton Superior, or approved equal.

G. Other Materials: Provide all items required to complete work which is not specified, or which is not to be provided by other trades.

H. Extruded Concrete Curbs:
1. Materials:
   a. Portland Cement: ASTM C150, Type I.
   b. Aggregate: ASTM C33.
   c. Water: Clean, free of contaminating material.

2. Epoxy Adhesive: As specified under concrete materials above.
3. Concrete Mixing:
   a. Slump: No slump allowed.
4. Curing Compound: As specified under concrete materials above.

I. Traffic and Zone Marking Paint: (As shown on drawings or required)
1. Type: chlorinated rubber paint conforming to the requirements of TT-P-115E. Sherwin Williams product Setfast Chlorinated Rubber Zone Marking Paint TM5126 – White and TM5127 – Yellow or approved equal.
2. Stripe Size: Four (4) inches wide for traffic and parking lanes, unless noted otherwise.
3. Colors:
   a. Traffic and Parking Striping / crosswalks, directional arrows: White or as selected by Architect.
   b. Fire Lanes: All curbs at driveways adjacent to building shall be painted solid red with white stenciled lettering to read “FIRE LANE, NO PARKING” in size and spacing required by authorities having jurisdiction. Contractor to verify requirements of local jurisdiction for fire lane striping.
   c. Accessibility Handicapped Parking: Symbols and spaces shall be in size and color in accordance with ADA and TAS authorities having jurisdiction.

J. Precast Concrete Wheel Stops: (As shown on drawings or required)
1. **Precast of 3,000 psi air-entrained concrete, approximately 9.5 inches high x 12 inches wide x 8 feet-0 inches long, with chamfered top corners and drainage slots underneath for buses (please refer to plans). Unit shall weigh minimum 800 lbs.**
2. **Precast of 3,000 psi air-entrained concrete, approximately 6 inches high x 9 inches wide x 6 feet-0 inches long, with chamfered top corners and drainage slots underneath for vehicles (please refer to plans). Unit shall weigh minimum 190 lbs.**
3. Anchor Rods: Two (2) No. 4 by 12-inch-long anchor rods located approximately 12 inches from each end of wheel stop.
4. Epoxy Adhesive: As specified under concrete materials above.

K. ADA Detectable Warning Paver
1. As produced by Pavestone or approved Equal.
2. Color as approved by Architect.

PART 3 - EXECUTION

3.1 PREPARATION

A. Review approved mix designs with Architect in field.

B. Clean all mixing and transportation equipment; remove debris from forms; wet forms thoroughly; remove ice and other coatings from reinforcement which might hinder good bond; remove water from place of deposit; and check reinforcement.

C. Inspection: Examine all areas and conditions under which the Work of this Section will be performed. Correct any conditions detrimental to the approved completion of the work. Do not proceed until all such conditions are corrected.

D. If thickness of concrete pavement is not labeled on the drawings, the thickness shall be 6-inch thick.

3.2 INSTALLATION

A. Forms:

1. Conform to the shapes, lines and dimensions of the members as shown on the drawings, except as modified under the Earthwork Section of these specifications. Review depths with Architect in field.
2. Care shall be taken to assure that formwork does not stain concrete surfaces.
3. Slab Block-Outs:
   a. Diamond configuration at paving drains, round or diamond configuration at bollards, fence posts and the like.
   b. Coordinate with concrete joints, verify with Architect.
4. Slope exterior concrete slabs away from building and towards paving drains. Verify all slopes with Architect prior to start of concrete pour.
5. Form Removal:
   a. Remove only after concrete has thoroughly hardened.
   b. Vertical forms for ground-supported slabs may be removed 24 hours after pour.

B. Reinforcing:
1. Cleaning Reinforcement: Free from rust, scale, dirt, or other coatings which will destroy or reduce the bond.
2. Placing Reinforcement:
   a. Place accurately and adequately secure in position.
   b. Bar reinforcement in all concrete slabs shall be held in proper locations by use of plastic chairs spaced a maximum distance of 36 inches on center unless noted otherwise.
3. Coverage of Reinforcement: The metal reinforcement shall be protected by the thickness of concrete indicated on the plans.
   a. Three (3) inches: Concrete deposited against ground without use of forms.
   b. Two (2) inches: Bars more than 5/8-inch diameter where concrete is exposed to the weather or exposed to the ground but placed in forms.
   c. 1-1/2 inches: Bars 5/8-inch diameter where concrete is exposed to the weather or exposed to the ground but placed in forms.
   d. Two (2) inches: In slabs and walks on grade.
   e. 1-1/2 inches-1-3/4 inches from top: Paving

C. Joints:
1. Construction Joints:
   a. Shall occur at expansion joints.
   b. Use at cold joints in paving slabs.
2. Expansion Joints:
   a. Locate fiber joint filler type where walks and paving abut curbs and at perimeter of slab infill. Joints shall be continuous and full depth and width of slab. Stop 3/4-inch-thick fillers 1/2 inch below top of paving and 1/2-inch-thick fillers 3/8 inch below top of paving for subsequent application of sealant cap; sealant to be applied to within 1/8 inch of slab surface. Verify other locations with Architect where asphalt impregnated fiber joint filler and sealant cap is to be used.
   b. Locate redwood expansion joints at paving and walk expansion joints where indicated, complete with load transfer units as specified herein and detailed. Joints shall be continuous and full depth and width of slab. Except where detailed without sealant cap, stop expansion joints 1/2 inch below top of paving for subsequent application of sealant cap. Top surface of sealant shall be approximately 1/8 inch below top of adjacent concrete. Install sealant in accordance with manufacturer's instructions. For applications where no sealant cap is to be applied, stop expansion joints 1/8 inch below top of paving surface. Verify other locations with Architect where redwood expansion joint and sealer cap is to be used.
   c. Install redwood expansion joints 5 feet either side of water lines under pavement.

3. Load Transfer Units: Install straight and true, and in accordance with manufacturer's instructions.

4. Tooled Joints:
   a. Steel tool all control joints, edges of expansion joints, and all exposed perimeter edges to smooth bullnose, using an edger having a radius of 1/4 inch, as approved.
   b. Form control joints in uniform straight lines in locations indicated, but in no case greater than 5 feet apart, uniformly spaced.

D. Accessories: Install accessories and boxes, sleeves and other required devices furnished by other trades.

E. Concrete:
1. Conveying:
   a. Batching, mixing and Delivery Equipment: Use transit mixed concrete from approved batching and mixing plant. Batch, mix, and transport concrete to the site in accordance with provision of ASTM C94.
   b. Where colored concrete is shown or required, i.e. accessible ramps, use color pigment admixture in concrete. Mix color pigment into concrete in accordance with manufacturer's recommendations to achieve integrally pigmented concrete in specified colors or as selected by Architect.
   c. Handling concrete from point of delivery and transfer to conveying equipment and to location of final deposit as rapidly as practicable and by methods which prevent segregation and loss of mix materials.
   d. Provide runways for wheeled conveying equipment from delivery point to location of final deposit.
   e. Keep interior surfaces of conveying equipment, including chutes and tremies, free from hardened concrete, debris, water and other deleterious materials.
   f. Pumps may be used only if they can pump the mix designed. Do not add fine aggregate or water to the mix to satisfy needs of a pumping device.
   g. Use chutes or tremies for placing concrete where a drop of more than 6'-0" is required.
   h. Addition of water on the job - The maximum water-cement ratio should never be exceeded. If all the water allowed by the specification has not been added at the start of mixing, it may be permissible to add the remaining allowable water at the point of delivery.

2. Concrete Placement, General:
   a. Place concrete in compliance with practices and recommendations of ACI 304, and as specified herein.
   b. Do not deposit concrete on concrete which has hardened sufficiently to form seams or planes of weakness within the section.
   c. Sections between expansion joints shall be placed in continuous pours; construction joints in paving and walks other than at expansion joint locations will not be permitted.
   d. Place concrete at such a rate that concrete which is being integrated with fresh concrete is still plastic.
   e. Deposit concrete as nearly as practicable in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which might cause segregation.
   f. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming and grouting.
   g. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials.
3. Slab Placement:
   a. Moisten subgrade the evening before and immediately prior to placement of all paving slabs.

b. Deposit and consolidate concrete slabs in a continuous operation, within the limits of all expansion joints, until the placing of a panel or section is completed using vibrating bridge screeds, roller pipe screeds or other methods acceptable to Architect.
c. Consolidate concrete during placement by use of the specified equipment, preferably with power driven floats of impact type, thoroughly working concrete around reinforcement and into corners.
d. Bring slab surfaces to correct level with a straight edge, and then strike off.
e. Use bull floats or darbies to smooth the surface, leaving it free from bumps and hollows.
f. Do not sprinkle water on the plastic surface; do not disturb the slab surfaces prior to start of finishing operations.

4. Extruded Curb Placement:
a. Install to detail in locations shown.
b. Apply epoxy resin adhesive to paved surface prior to extruding curb.
c. Machine extrude concrete to shape detailed on Drawings, as approved. Trowel form concrete curbs in areas where machine cannot reach.
d. Install pre-molded expansion joints where curbs meet poured-in-place concrete and at 60 lineal feet maximum spacing; elsewhere where indicated.
e. Cut crack control joints every 20 lineal feet and at beginning of curves with less than five (5) foot radius.
f. Hand trowel rough areas to a dense, uniform texture. Bevel curbs 45 degrees at dead ends.
g. Spray apply membrane forming curing compound after curb installation.
h. Remove and replace curbs which crack; cut out chipped or cracked areas and reinstall new extruded curbs.
i. Remove excess concrete from paving surfaces.

F. Curing:
1. General:
a. Protect all freshly placed concrete from premature drying and excessive hot or cold temperature extremes. Start curing procedures on slabs immediately after finishing operation.
b. Maintain curing procedures for seven (7) days at minimum temperature of 50 degrees F.; if mean daily temperature drops below 40 degrees F. during this period, extend curing period an equal number of days or provide temporary heat or additional protection to maintain specified minimum temperature of air in contact with concrete.
2. Curing Exterior Paving and Slabs: Spray paving, walks, curbs and other miscellaneous slabs with liquid membrane-forming compound specified above, applied at not less than the manufacturer's specified and recommended rate.

G. Finishes:
1. Spreading of dry cement for finishing is not permitted.
2. Finish all exposed edges and joints with edging tools of 1/4 inch radius.
3. Exterior Paving and Slabs:
a. Floating: Do not begin floating until bleed water sheen has disappeared or until leveled material has stiffened sufficiently for power floating. After power floating, re-float by hand immediately to uniform, true, smooth, granular surface within the specified tolerance.
b. Medium Broom Finish: Broom after floating and concrete is hard enough to retain scoring. Use a stiff fiber or wire broom. Broom perpendicular to direction of traffic, typically. Broom in opposite directions at sidewalk panels in a checkerboard pattern or as indicated on drawings.
4. Handicapped Accessible Ramps: Slope surfaces as shown on drawings. Texture ramp by providing raised, truncated domes on the surface of the ramp in accordance with TAS.

1) New Concrete Ramps: Integrally color concrete in color selected by Architect from manufacturer's standard colors to provide contrasting color to that of adjacent concrete.
2) Existing Concrete Ramps: Stain concrete using specified concrete stain in color selected by Architect from manufacturer's standard colors to provide contrasting color to that of adjacent concrete.
   a) Prior to applying any stain, existing concrete ramps shall be cleaned up of all dirt, oil, grease, and other contaminates.
   b) Acid etch with 25 percent muriatic acid solution.
   c) Power wash at 3,000 psi.
   d) Water test to determine if water absorbs, thereby making it good to stain.
   e) Allow concrete to thoroughly dry.
   f) Apply stain in accordance with manufacturer's instructions.

   Note: All colors must be approved by Architect prior to their use. Failure to do so, may be cause for rejection of work and removal and replacement of work with new work at Contractor's expense.

5. Miscellaneous Vertical Surfaces: Finish all vertical surfaces, including but not limited to curbs, risers, low walls and stringer, while concrete is strong enough to stay in place without forms yet green and able to be finished to a homogeneous appearance.

H. Traffic Lane, Parking Space, and Zone Paint Striping: (As shown on drawings or required)
1. Surface Conditions: Clean and dry, free from dirt, loose paint, oil, grease, wax and other surface contaminants which would affect paint bond.
2. Allow concrete surfaces to cure the minimum time recommended by the traffic marking paint manufacturer, but in no case less than 30 days prior to applying traffic marking paint.
3. Locate markings as indicated on drawings. Do not apply paint until layout is verified with Architect. Protect surfaces which are not to receive paint.
4. Mix paint and apply in accordance with manufacturer's instructions, using skilled labor and proper mechanical equipment to produce uniform, straight lines without bleeding edges or runs.
5. Paint traffic, parking lanes, and accessibility handicapped parking lines as shown on drawings and to comply with requirements of authorities having jurisdiction.
6. Paint curbs and stenciled signs for FIRE LANES, NO PARKING, and BUS LOADING areas, crosswalks, handicapped accessible parking spaces, and other areas shown on drawings or required by authorities having jurisdiction. Use proper type, style and size stencils for all numbers and lettering. Do not apply paint until layout is verified with Architect and/or authorities having jurisdiction. Protect surfaces which are not to receive paint.

I. Precast Concrete Wheel Stops: (As shown on drawings or required)
1. Surface Conditions: Clean and dry, free from dirt, loose paint, oil, grease, wax and other surface contaminants which would affect epoxy bond.
2. Locate wheel stops as indicated on drawings.
3. Predrill holes in concrete paving for anchor rods.
4. Secure wheel stops in 1/8-inch-thick x 3-inch-wide epoxy and drive anchor rods through predrilled holes filled with epoxy grout.

J. ADA Detectable Warning Paver
1. Install per manufacturer's details and requirements.

3.3 FIELD QUALITY CONTROL

A. Inspection and Testing Laboratory:
1. Perform the appropriate tests upon notification by the Contractor.

B. Tolerances:

1. Slope as shown on drawings.
2. Paving sections containing “bird baths” greater than two (2) feet in diameter or 1/8 inch deep (regardless of the size of the area) will be removed and re-poured at the Contractor’s expense.

3.4 PATCHING AND CLEANING

A. Clean exposed concrete surfaces and adjoining work stained by concrete leakage to the Architect's approval.

B. Reinforce or replace all deficient work as directed by the Architect and at no additional cost to the Owner.

C. Clean all concrete and cement work upon completing this portion of the work.

3.5 DEFECTIVE WORK

A. Imperfect or damaged work, as determined by the engineer, shall be satisfactorily replaced at the Contractor’s expense and shall be in conformity with all the requirements of the Contract Documents. Removal and replacement of concrete work shall be done in such a manner as not to impair the appearance or strength of the structure in any way.

3.6 PENALTY FOR DEFICIENT PAVEMENT THICKNESS

A. It is the intent of this specification that the pavement be constructed in strict conformity with the thickness and typical sections shown on drawings. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern.

B. Prior to final acceptance, and if deemed necessary by the Engineer, the pavement will be cored by the Testing Laboratory. Locations of core tests may be selected by the Engineer. Regular testing shall occur for every five hundred (500) square yards of placed concrete pavement and at random locations.

C. For the purpose of establishing an adjusted price for pavement, units to be considered separately are defined as 500 square yards of pavement.

D. One core will be taken at locations selected by the Engineer or at random in each unit and tested in accordance with ASTM Method C-174. When measurement of the core from any unit is not deficient more than 0.2 inches from the plan thickness, full payment will be made.

E. If the measurement of any core from any unit is deficient more than 0.2 inch but not more than 0.50 inch from the plan thickness, two additional cores will be taken from the unit, and the average of the three cores will be determined. The two additional cores will be taken so that the unit will be well represented. If the average thickness of the three cores is deficient more than 0.2 inch but not more than 0.50 inch from the plan thickness, an adjusted unit price as provided below, will be paid for in these areas represented by these cores. At the option of the Engineer, additional cores may be taken in the adjacent unit/units to determine if the deficiency of thickness continues across all lanes of pavement. If the deficiency exists in one (1) or more adjacent units, adjusted unit prices as provided below will be paid for those adjacent units that are found to be deficient.

F. Price Adjustments: Concrete Pavement Deficiency

Deficiency in Thickness Determined by Cores (in inches)	**Proportional Part of Contract Price Allowed (adjustment factor)**
No deficient	1.0

Over 0.00 through 0.20	1.0
Over 0.20 through 0.30	0.80
Over 0.30 through 0.40	0.72
Over 0.40 through 0.50	0.68
Over 0.50	0.50 or removal*

*At the option of the Engineer.

G. Any area of pavement found deficient in thickness by more than 0.50 inch but not more than 0.75 inch shall be evaluated by the Engineer. If, in the judgement of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgment of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness shown on the drawings. Any area found deficient in thickness by more than 0.75 inch shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness shown on the drawings.

H. No additional payment over the contract price will be made for any pavement of a thickness exceeding that required on the drawings. Also, planing of concrete pavement shall not be allowed.

END OF SECTION 32 13 13

SECTION 32 16 13 - CONCRETE CURB, GUTTER, SIDEWALKS & DRIVEWAYS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This Section shall govern for curb, gutter, combined curb and gutter, sidewalks and/or driveways, with or without reinforcing steel composed of Portland cement concrete constructed on approved subgrade, foundation material or finished surface in accordance with the lines and grades established by the Engineer and in conformance with the details shown on the plans. As used in this Section, the word "curb" refers to concrete curb, concrete gutter and combined concrete curb and gutter.

1.2 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Concrete used in conventionally formed and extruded construction shall be 3,500 psi (at 28 days) concrete having 5.5 sacks of cement per cubic yard and ¾" coarse aggregate.

B. Reinforcing steel, if required, shall conform to the requirements of Section 03210 - Reinforcing Steel.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. For conventionally formed concrete, the subgrade, foundation, or pavement surface shall be shaped to the line, grade and cross-section and if considered necessary by the Engineer, hand tamped and sprinkled. If dry, the subgrade or foundation material shall be sprinkled lightly immediately before concrete is deposited thereon.

B. Outside forms shall be of wood or metal, of a section satisfactory to the Engineer, straight, free of warp and of a depth equal to the depth required. They shall be securely staked to line and grade and maintained in a true position during the depositing of concrete. Inside forms for curbs shall be of approved material, shall be of such design as to provide the curb required and shall be rigidly attached to the outside forms. The reinforcing steel shall be placed in the position shown by the plans. Care shall be exercised to keep all steel in its proper location.

C. After the concrete has been struck off and after it has become sufficiently set, the exposed surfaces shall be thoroughly worked with a float. The exposed edges shall be rounded using an edging tool to the radius indicated on the plans.

D. Sidewalks shall be constructed in sections of the lengths shown on the plans. The different sections shall be separated by a board joint of the thickness shown on the plans, placed vertically and at right angles to the longitudinal axis of the sidewalk. Where the sidewalks or driveways abut a curb or retaining wall, approved expansion material shall be placed along their entire length. Similar expansion material shall be placed around all obstructions protruding through sidewalks or

driveways. Sidewalks shall be marked into separate sections, as shown on plans, using approved jointing tools.

E. Curbs, gutters and curb and gutters shall be placed in sections of 45-foot maximum length unless otherwise shown on the plans. Joints shall be constructed at such locations and of the type as directed and specified on the plans.

F. For extruded concrete construction, the concrete shall be placed by an extrusion machine approved by the Engineer. When placement is directly on subgrade or foundation materials the foundation shall be hand-tamped and sprinkled if considered necessary by the Engineer. If the concrete is placed directly on the surface material or pavement, such surface shall be thoroughly cleaned. If required by plan details, the cleaned surface shall then be coated with an approved or other coating as specified at the rate of application shown.

G. The line shall be maintained from a guideline set by the Contractor. The outline shall strictly conform to the details shown on the plans. The forming tube of the extrusion machine shall be readily adjustable vertically, during the forward motion of the machine to provide variable heights necessary to conform to the established grade line. To provide a continued check on the grade, a pointer or gauge shall be attached to the machine in such a manner that a comparison can be made between the extruded work and the guideline. Other methods may be used if approved by the Engineer.

H. The mix shall be fed into the machine in such a manner and at such consistency that the finished work will present a well compacted mass with a surface free from voids and honeycomb and true to the established shape, line and grade.

I. Any additional surface finishing specified and/or required, shall be performed immediately after extrusion. Joints shall be constructed at such location as directed by the Engineer and to the details shown on the plans.

J. When sidewalks are to be placed adjacent to a curb or a curb and gutter, the sidewalk and curb, or curb and gutter may be placed monolithically in one pass of the machine, provided the work is satisfactory to the Engineer.

K. All concrete under this item shall contain 4% + 1-1/2% entrained air. The completed work shall be cured for not less than 72 hours.

END OF SECTION 32 16 13

SECTION 32 17 23.13 - PAINTED PAVEMENT MARKINGS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

A. This item shall govern for the materials, composition, manufacture, testing, and installation of all traffic paint and related materials as covered herein.

1.2 SUBMITTALS

A. Submit product data and shop drawings for ALL items to be installed.

B. Refer to Section 01 33 00 for submittal procedures.

1.3 MEASUREMENT & PAYMENT

A. No separate measurement for payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 CONFORMANCE OF FINISHED PRODUCTS

A. Coatings shall conform, on a weight basis, to the composition requirements of the standard formula. No variation from the standard formula will be permitted except for replace of volatiles lost in processing, or those approved by the Engineer. The finished coatings shall conform with all requirements stipulated for each standard formula, and, in addition, shall equal a Wet Standard in characteristics such as color, drying, flow, settling, brush ability, can stability, hiding, etc.

B. Film characteristics such as gloss, hardness, light permanency, adhesion, etc., shall also conform. When testing for such conformity, the coating shall be applied and tested under parallel conditions with the Wet Standard. The finished product shall be free of skins and foreign materials.

PART 3 – EXECUTION

3.1 MILL TESTS AND TESTING

A. All paint contractors shall be required to furnish to the Owner a copy of certified Mill test report for all paint to be furnished and delivered. Testing shall be in accordance with TxDOT.

B. Raw materials and finished products which fail to meet any requirements of these specifications shall be subject to rejection. Final acceptance or rejection shall be based on results of tests on samples of raw materials and paint taken during production, and upon tests made on finished paints prior to delivery. Approval of materials, as a result of preliminary testing prior to manufacture into finished coatings, shall not be binding upon final approval or rejection. The judgment of the Engineer shall be final in all questions relative to conformance with the provisions of these specifications. 661.6 Manufacturing procedures, except when specified, shall be left to the discretion of the contractor. It is the responsibility of the manufacturer to ascertain that the raw

materials and manufacturing procedures he proposes to use will produce a product meeting the specification requirements.

3.2 SHIPMENT

A. Shipment shall be made in suitable, strong, well sealed containers which not only meet specifications and Federal requirements but are also sufficiently sturdy to withstand normal handling to which shipments are subjected in transit. Finished coating containers and cases shall be plainly and securely labeled with the name and the designation of the coating, order number, requisition number, batch number, date of manufacture, gross weight, and manufacturer's name. Labeling shall be on the sides of container and cases. Labels must be sufficiently moisture-resistant to withstand outdoor storage for a minimum of one year.

B. When the finished product is palletized for shipment, the labels shall be to the outside for easy identification. Once the finished product has been labeled properly, the label shall not be modified or changed in any manner without specific approval of the Engineer.

3.3 RAW MATERIALS

A. Raw materials for Traffic Painting shall adhere to Item 661 – Traffic Paint of the Harris County Engineering Department Year 2017 Specifications or latest edition, or **Fast Drying Alkyd, Low VOC Chlorinated Rubber Traffic Paint as per drawings.**

B. Color to be traffic white, yellow, or as designated on the drawings.

3.4 INSTALLATION METHODS

A. All traffic paint applications shall meet the following requirements:
   1. Traffic paint shall be applied at the rate of one gallon of un-thinned paint per 105 square feet of surface area.
   2. Traffic paint shall be applied in two (2) coats with each coat having a minimum thickness of 15 mils, measured in a wet condition.
   3. Paint striping shall be applied and measured to ± 1/4" of the specified widths.

B. All traffic paint striping not meeting these requirements shall be "touched up", removed and/or completely restriped to these standards and in accordance with the drawings at no additional cost to the Owner, as directed by the Engineer.

C. Where traffic buttons exist, the paint shall be applied to the pavement adjacent to, but not on the buttons or markers, unless another method is specified.

D. Word and symbol markings on pavement shall be in accordance with "Pavement Word and Symbol Markings" Section of the latest Texas Manual on Uniform Traffic Control Devices of the TxDOT.

3.5 TESTING

A. When required, the contractor shall pay for and provide to the Engineer, a testing report performed by a local testing laboratory designated by the Engineer. The report shall verify that the raw and finished materials to be supplied under this contract meet the requirements of this specification.

3.6 REJECTION

A. Materials and finished products which fail to meet any or all requirements of these specifications shall be subject to rejection. All materials and finished products rejected by the Engineer, whether in containers or applied to roadway surface shall be removed from the jobsite and replaced with

materials meeting specifications and requirements and all costs of such removal and replacement shall be borne by the Contractor.

END OF SECTION 32 17 23.13

SECTION 32 31 13 - CHAIN LINK FENCE AND GATES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This item governs for furnishing all labor materials, and equipment necessary to provide all chain link fencing complete, including terminal posts, gates, posts, tension wire, wire, top rail, and fittings, where indicated on the Drawings.

1.2 SUBMITTALS

A. Submit product data and shop drawings for ALL items to be installed.

PART 2 - MATERIALS

2.1 WIRE FABRICS

A. Fabric shall be of chain-link wire woven in a 2 inch iron mesh. Fabric to be woven of #9 gauge wire before galvanizing.

B. The fabric shall be zinc-coated by the hot-dip process after weaving, with any grade of zinc conforming to ASTM B 6. The weight of zinc-coating shall be not less than 1.2 ounces of zinc per square foot of actual surface covered.

C. Wire shall be AISI Specification C 10-18 carbon steel wire with a minimum of 0.10 and a maximum of 0.20 silicon added. The wire shall stand a tensil-strength test of 80,000 pounds per square inch based on a cross section of galvanized wired.

2.2 LINE POSTS

A. Line posts shall be hot-dipped, galvanized steel 2.5" O.D., weight 3.65 pounds per linear foot, iron pipe schedule 40 pipe, minimum wall thickness 0.154 inch spaced on centers not to exceed 10 feet. Fabric shall be attached to line post with No. 6 gauge galvanized clips on 14-inch centers. Posts shall be set in Class A (3000 psi) concrete in a 9-inch diameter hole not less than 36 inches deep. Galvanizing shall be any grade of zinc conforming to ASTM B 6.

2.3 TERMINAL POSTS

A. End, corner and pull posts shall be hot-dipped galvanized 3-inch O.D. standard pipe, weight 5.79 pounds per linear foot, minimum wall thickness 0.216, equipped with hot-dipped galvanized 1 1/2-inch I.D. pipe weight 2.27 pounds per linear foot minimum wall thickness 0.145 inch horizontal braces and 3/8-inch galvanized truss rods complete with truss tightener set in Class A concrete in a 10-inch diameter hole not less than 42 inches deep. Galvanizing shall be any grade of zinc conforming to ASTM B 6.

2.4 TERMINAL POST FITTINGS

A. All terminal post fittings, including tension bands and brace connections, shall be made of not less than 14-gauge hot-dipped galvanized steel. Brace and truss bands shall be a minimum of 7/8-inch wide; tension bands shall be a minimum of 3/4-inch wide.

B. Bands shall be manufactured in a fashion which will not result in sharp and dangerous edges. All bands and connections to be securely fastened with 5/16-inch x 1-1/4-inch galvanized carriage bolts and nuts. Stretcher bars shall be hot-dipped galvanized a minimum of 3/4-inches wide and 3/16-inches thick and sheared ends shall be given two coats of aluminum paint.

C. No aluminum or pot metal fittings will be accepted.

2.5 TOP RAILS

A. Top rails shall be of galvanized 1-1/2-inch I.D. pipe weighing 2.27 pounds per linear foot, minimum wall thickness 0.145 inch with outside sleeve-type couplings at least 7 inches long; one coupling in every five shall have a heavy spring to permit expansion and contraction of the rails. Couplings shall be within 1 foot of line posts. no couplings will be allowed in mid-span Fabric ties to the rails shall be of No. 9 gauge tie wires at 24-inch centers. A No. 7 gauge coiled spring steel tension wire having a zinc coating of 0.80 ounces zinc per square foot of surface area shall be provided along bottom of fence. Fabric shall be fastened to tension wire at intervals of 2'-0" with pig rings.

2.6 GATE POSTS

A. All gate posts shall be hot-dipped galvanized 6-inch O.D. standard pipe, weighing 18.97 pounds per linear foot, minimum wall thickness 0.280 inch.

B. Posts shall be set in Class A concrete in a hole whose diameter shall not be less than four (4) times the diameter of the post and not less than 48 inches deep.

C. Gate post shall have a ball top or top of manufacturer's standard design to exclude moisture from the gate post.

2.7 GATES

A. Gate frames shall be fabricated of 2-inch O.D. hot-dipped galvanized pipe, weighing 2.72 pounds per linear foot, minimum wall thickness 0.154 inch with galvanized pressed steel or malleable iron corner ells, securely riveted to pipe frame with 4 rivets per corner. Internal bracing shall be 1-5/8-inch O.D. hot dipped galvanized pipe weighing 2.27 pounds per linear foot with 3/8-inch adjustable truss rods.

B. Bottom hinge shall be ball and socket type or type allowing pivot on vertical member of gate frame preventing removal of gate without dissembling of hinge, made of steel upper hinges shall be 180 deg. wrap-around type, made of galvanized steel to allow gate to swing 180 deg. Gates shall be complete with pad-locking device; center rests and semi-automatic catch to secure gates in open positions.

C. Fabric shall match that used in the line fence and shall be centered in the frame, attached by means of tension bars and hook bolts. Top bar of gate frame shall be on level plane and at the same height as top tension fence rail.

2.8 BRACES

A. Braces material shall be the same as top rail and shall be Hot Dip Galvanized. Braces shall be spaced midway between top rail and ground, and shall extend from terminal post to first adjacent line post. Braces shall be securely fastened to posts by suitable pressed steel connections, then trussed from line post back to terminal post with 3/8" round rod.

2.9 FITTINGS

A. All fittings shall be malleable, cast iron or pressed steel, hot dip galvanized. No aluminum or inferior

metal will be permitted for line post tops, bands or gate corners.

2.10 FABRIC BANDS

A. The fabric shall be fastened to the top rail with aluminum tie wires spaced approximately 18 inches apart. The fabric shall be fastened to the line posts with No. 7 gauge hard drawn galvanized carbon steel fabric bands spaced approximately 12 inches apart.

2.11 TENSION WIRE

A. A No. 7 gauge coil drawn tension wire shall be provided at the bottom of the fabric for the entire length of the fence. The Tension wire shall be tied to the fabric at not over 24 inch centers and to the posts. Fence shall stand six feet high above ground when erected.

2.12 SCREENING SLATS

A. Materials: Extruded high density virgin polyethylene, containing color pigmentation and U.V. inhibitors to resist the effects of ultra violet radiation from sunlight and extend the colorfasteness of the material.

B. Profile: flat tubular shape with a profile depth of 0.312 inch (5/16 inch) and a wall thickness of 0.020 inch.

C. Width: 1-1/16 inch (1.062 inch).

D. Height: Fabricated 3-1/2 inches shorter than the overall height of the fence and gates.

E. Locking System: manufacturer's self-locking horizontal bottom channel system.

F. Color: Gray

G. Product/Manufacturer: PDS Brand Privacy & Decorative Slatting as manufactured by PDS Fence Products (509) 248-9955, or approved equal by Davidson Plastics Corporation (800) 822-7528.

PART 3 – EXECUTION

3.1 ERECTION

A. The fence shall be installed by skilled and experienced fence erectors and on the lines and grades specified. All posts shall be set plumb and in concrete footings of the size specified under various post specifications. The concrete shall extend a minimum of three (3) inches below the bottom of the posts.

END OF SECTION 32 31 13

SECTION 32 31 19 – DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes the following:
   1. Steel ornamental fences with solid steel pickets.
   2. Pedestrian gates.

B. Related Sections include the following:
   1. Division 2 Section "Earthwork" for filling and for grading work.
   2. Division 3 Section "Cast-in-Place Concrete" for concrete post footings.

1.3 DEFINITIONS

A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 SUBMITTALS

A. Submit product data in the form of manufacturer's technical data, specifications, and installation instructions for fences and gates.

B. Shop Drawings: Submit shop drawings showing location of fence and gates, including each post, details of post installation, hardware, and accessories. Show sizes and thicknesses of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work, and other pertinent details of fabrication and installation.

C. Samples for Verification: Submit samples for each profile and pattern of fabricated metal and for each type of metal finish required, prepared on metal of same thickness and alloy indicated for the Work. Include samples of the following:
   1. Post cap including 12 inch (300-mm) long section of post.
   2. Full-size sample of fence, 2 feet wide by full height.
   3. Gate hardware including hinges and latch.

D. Qualification Data: Submit qualification data for fabricator.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Arrange for installation of ornamental metal fences and gates specified in this Section by the same firm that fabricated it.

B. Fabricator Qualifications: A firm experienced in producing ornamental metal fences and gates similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.6 REFERENCES

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.

C. ASTM D523 - Test Method for Specular Gloss.

D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.

E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.

F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.

J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.7 WARRANTY

A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase

PART 2 - PRODUCT

2.1 MANUFACTURER

A. Provide ornamental metal fences and gates as manufactured by Montage II – Heavy Industrial Steel Ornamental Fence System as manufactured by Ameristar Fence Products, Inc. (918) 835-0898 or comparable product approved by the Architect.

2.2 MATERIALS

A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft2 (276 g/m2), Coating Designation G-90.

B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1. 75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.3 FABRICATION, GENERAL

A. Pickets, rails, and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).

C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
   1. Color: Architect to select from manufacturer's full range.

D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.

F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48" width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" - 1.375") and vertical (0 - .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.

G. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fences and gates in accordance with approved shop drawings. Do not begin installation and erection before final grading is established.

B. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
   1. If not indicated on Drawings, excavate holes for each post 6 to 8 inches in diameter.
   2. Unless otherwise indicated, excavate hole depths not less than 36 inches below the finish grade surface.

C. Setting Posts in Earth: Center and align posts in holes, space as required by manufacturer. Brace terminal post against structure as required.
   1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
      a. Unless otherwise indicated, set top of concrete footings 4 inches below finish grade.

D. Setting Posts in Stone or Existing Concrete:
   1. Core drill 3-1/2 inch diameter holes 9 inches deep.
   2. Clean holes of loose material, insert posts, and fill space around post with exterior erosion-resistant anchoring cement, mixed and placed to comply with manufacturer's written instructions.
   3. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8 inch buildup, sloped away from post.

E. Fence Assembly: Install fully assembled fence sections as indicated on Drawings. Set bottom rail of fence 3 inches above finish grade unless indicated otherwise.

3.2 CLEANING AND PROTECTION

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work.

PART 4 - TABLES

Table 1 – Minimum Sizes for Montage II Posts

Fence Posts	Panel Height
2-1/2" x 12 Ga.	Up to & Including 6' Height
3" x 12 Ga.	Over 6' Up to & Including 8' Height

Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.

6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

Table 2 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 – Montage II – Post Spacing By Bracket Type

Span	For INVINCIBLE® 8' Nominal (91-1/2" Rail)				For CLASSIC, GENESIS, & MAJESTIC 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2" (BB319) 3" (BB320)		Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± ½" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"

*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.

END OF SECTION 32 31 19

SECTION 32 91 19.13 - TOPSOIL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Work shall include all materials, labor, equipment, transportation, and services necessary to furnish and place topsoil for finish grading, seeding, sodding, and planting as shown on the drawings and as specified herein.

1.2 QUALITY ASSURANCE

A. Contractor to attend a pre-installation meeting and participate in an installation meeting with Owners Representative.

PART 2 – MATERIALS

2.1 TOPSOIL

A. Provide topsoil which is fertile, friable, natural loam, surface soil, free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 2 inches in any dimension and other extraneous or toxic matter harmful to plant growth.

B. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches. Topsoil shall not be collected from sites that are infected with growth of, or the reproductive parts of noxious weeds, especially nut grass. Topsoil shall not be stripped, collected or deposited while wet. Topsoil shall not be excessively acid or alkaline or contain toxic substances which may be harmful to plant growth. Topsoil shall be without admixture of subsoil.

PART 3- EXECUTION

3.1 EXAMINATION

A. Excavation and subgrade shall be checked and verified that they have been completed to correct lines and grades.

3.2 INSTALLATION

A. Topsoil installment is to be coordinated to coincide with irrigation placement and is to be spread according to plan grades.

3.3 CLEAN UP

A. Spilled topsoil shall be removed from paved areas, curbs, gutters, etc. As operations proceed all excess soil and debris shall not be allowed to accumulate but shall be removed daily and the site kept as clean as possible.

3.4 PROTECTION

A. Topsoil shall be protected from wind and water erosion until planting is completed.

END OF SECTION 32 91 19.13

SECTION 32 92 13 - HYDRO-MULCH SEEDING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this section consists of furnishing all plant, labor, materials, equipment, supplies, supervision and tools and performing all work necessary to top soiling, smoothing, seeding, fertilizing, watering maintenance and cleanups of side slopes, all in accordance with these specifications.

B. The hydro-mulch seeding operations, together with all necessary related work, shall conform to the requirements specified in this section. The area(s) to be hydro-mulch seeded shall be noted in the construction documents.

1.2 MEASUREMENT & PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. All seed must meet the requirements of the U.S. Department of Agriculture Rules & Regulations as set forth in the Federal Seed Act and the Texas Seed Law.

B. Type of seed, purity and germination requirements, rate of application and planting dates are as follows:

TABLE I

Type	Application Rate Pounds per Acre	Planting Date
Hulled Common Bermuda Grass 98/88	40	Jan. 1 to Apr. 15
Unhulled Common Bermuda Grass 98/88	40	Jan. 1 to Apr. 15
Annual Rye Grass, including Gulf	50	Jan. 1 to Apr. 15
Hulled Common Bermuda Grass 98/88	40	Apr. 15 to Oct. 1
Hulled Common Bermuda Grass 98/88	40	Oct. 1 to Jan. 1
Unhulled Common Bermuda Grass 98/88	40	Oct. 1 to Jan. 1

C. Fertilizer shall be water soluble with an analysis of 10 percent nitrogen, 20 percent phosphoric acid and 10 percent potash. Rate of application shall be 500 pounds per acre, except during the period of April 15 through September 1, when the rate shall be reduced to 400 pounds per acre. The fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable State Fertilizer Laws and bearing the name and warranty of the producer.

D. Mulch shall be virgin wood cellulose fiber made from whole wood chips. Within the fiber mulch material, at least 20 percent of the fibers will be 10.7mm in length and 0.27mm in diameter. Rate of application shall be 2000 pounds per acre. Soil Stabilizers such as Terra Type III (or approved equal) shall be applied at a rate of 40 pounds per acre on side slopes and Terra Tack I (or approved equal) shall be applied at a rate of 40 pounds per acre on flatter portions.

E. Wood cellulose fiber mulch, for use in the grass seed and fertilizer, shall be processed in such a manner that it will not contain germination or growth inhibiting factors. It shall be dyed an appropriate color to allow visual metering of its application. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover, which readily absorbs water and allows infiltration to the underlying soil. Weight specifications from suppliers for all applications shall refer only to the underlying soil. Weight specifications from suppliers, shall refer only to the air-dry weight of the fiber. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and must be marked by the manufacturer to show the dry weight content. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished and that it meets all of the foregoing requirements.

F. Water shall be free from oil, acid, alkali, salt and other substances harmful to the growth of grass. The water source shall be subject to approval, prior to use.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Immediately after the finished grade has been approved, begin hydro-mulching operations to reduce erosion and excessive weed growth.

B. Hydraulic equipment used for the application of fertilizer, seed and slurry of prepared wood fiber mulch shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend and homogeneously mix a slurry containing up to forty (40) pounds of fiber plus a combined total of 70 pounds of fertilizer solids for each 100 gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles, which provide even distribution of the slurry on the area to be seeded. The slurry tank shall have a minimum capacity of 800 gallons and shall be mounted on a traveling unit, which may either be self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded, so as to provide uniform distribution without waste. The Engineer may authorize equipment with a smaller tank capacity, provided the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

C. Care shall be taken that the slurry preparation take place on the site of the work. The slurry preparation should begin by adding water to the tank when the engine is at half throttle. When the water level has reached the height of the agitator shaft, good re-circulation shall be established and seed shall be added. Fertilizer shall then be added, followed by wood pulp mulch. The wood pulp mulch shall only be added to the mixture after the seed and when the tank is at least one-third filled with water. The engine throttle shall be opened to full speed when the tank is half filled with water. All the wood pulp mulch shall be added by the time the tank is two-third to three-fourths full.

Spraying shall commence immediately when the tank is full. The operator shall spray the area with a uniform visible coat, by using the green color of the wood pulp as a guide.

3.2 APPLICATION

A. The Contractor shall obtain approval of hydro-mulch area preparation from the Engineer prior to application.

B. Operators of hydro-mulching equipment shall be thoroughly experienced in this type of application. Apply the specified slurry mix in a motion to form a uniform mat at the specified rate. Operators shall keep the hydro-mulch within the areas designated and keep from contact with other plant material. Immediately after application, thoroughly wash off any plant material, planting areas or paved areas not intended to receive slurry mix.

C. Keep all paved and planting areas clean during maintenance operations. Contractor shall keep hydro-mulching within the areas designated and keep from contact with other plant material.

D. If in the opinion of the Engineer, unplanted skips and areas are noted after hydro-mulching, the Contractor shall be required to seed the unplanted areas with the grasses that were to have been planted at no additional cost to the Owner.

3.3 CONTRACTOR'S MAINTENANCE AND GUARANTEE PERIOD

A. The hydro-mulch seeding shall be adequately watered until established. Any areas damaged by erosion or areas that do not have any acceptable turfing shall be redone to the satisfaction of the Engineer. Maintenance of grass areas shall be for 60 days after the completion of the project and shall consist of watering, weeding, repair of all erosion and reseeding, as necessary to establish a uniform stand of the specified grasses. The Contractor shall guarantee growth and coverage of hydro-mulch planting under this contract to the effect that a minimum of 95% of the area planted will be covered with the specified planting after 60 days.

B. Prior to final acceptance, the Contractor shall be responsible for one (1) mowing per month between the months of April to September and shall mow every thirty (30) days plus or minus five (5) after the initial mowing. The Contractor shall also be responsible for one (1) mowing every six (6) weeks between the months of October to March. In addition, the Contractor shall water the entire sodded and hydro-mulched areas to a saturated depth of one (1) inch at least once a week between the months of April to September and at least once a month between the months of October to March.

C. The Contractor shall make a second application of specified hydro-mulch planting to those bare areas not meeting specified coverage as determined by the Engineer. Such replanting is to be performed within 60 days of initial application and upon notification by the Engineer to replant.

D. The Contractor shall apply top dress fertilizer (delayed action), at the rate of 10 pounds per 1000 square feet at 25 days after hydro-mulching of all new lawn areas.

E. Top dress fertilizer shall be 16-6-8.

END OF SECTION 32 92 13

SECTION 32 92 23 - FERTILIZER

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

A. Fertilizing shall consist of providing and distributing fertilizer over such areas as are designated for block sodding or seeding, for erosion control, and in accordance with these specifications.

1.2 MEASUREMENT

A. Acceptable material for "Fertilizer" will be measured by the C-WT (100 lbs) as determined by approved scales or guaranteed weight of sacks shown by manufacturer.

1.3 PAYMENT

A. No separate payment shall be made for materials furnished or work performed under this Section. Include the cost of same in the contract price bid for work of which this is a component part.

PART 2 – PRODUCTS

2.1 MATERIALS

A. All fertilizer used shall be delivered in bags or containers clearly labeled showing analysis. A pelleted or granulated fertilizer shall be used with an analysis of 10-10-5, unless otherwise specified. The figures in the analysis represent the nitrogen, phosphoric acid and potash nutrients respectively as determined by the methods of the Association of Official Agricultural Chemists. The sources of nitrogen in the fertilizer shall be roughly balanced between ammonical (quick release) and nitrate nitrogen (slow release).

B. With permission of the Engineer, fertilizer of a different analysis may be substituted. It shall be pelleted or granulated fertilizer with a lower concentration. The total amounts of nutrients furnished and applied per acre shall equal or exceed that specified for each nutrient.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. When fertilizer is included in the specifications, pelleted or granulated fertilizer shall be applied uniformly over the area specified to be fertilized and, in the manner, directed for the particular item of work. Fertilizer shall be dry and in good physical condition. Fertilizer that is powdered or caked will be rejected. Distribution of fertilizer for the particular item of work shall meet the approval of the Engineer.

B. Unless otherwise indicated on the plans, fertilizer shall be applied uniformly at the average rate of 480 pounds per acre when "Sodding for Erosion Control", and 400 pounds per acre when "Seeding for Erosion Control".

END OF SECTION 32 92 23

SECTION 32 92 23.16 - SOLID SODDING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

A. Solid Sodding for erosion control shall consist of providing and planting Bermuda grass, or other acceptable sod along or across such areas as are designated on the plans and in accordance with the specification requirements herein outlined.

1.2 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The sod shall consist of live, growing Bermuda grass (ninety-five percent pure), secured from sources where the soil is fertile and has been fumigated. Bermuda sod shall have a healthy virile root system of dense, thickly matted roots throughout and grown in a sandy loam soil consisting of a minimum of 60% sand. Sod grown in fat clayey materials are not acceptable. The sod shall be cut from the field so that there is a minimum of one-half inch of soil on the roots of the sod, and so that no roots show on the bottom of the soil. Sod shall be dense, with the grass having been mowed to 1-inch height before lifting from the field. Sod shall be in a vigorous condition, dark green in color, free of disease and harmful insects. The contractor shall not use sod from areas where the grass is thinned out, nor where the grass roots have been dried out by exposure to the air and sun to such an extent as to damage it stability to grow when transplanted. The sod shall be free from obnoxious weeds or other grasses and shall not contain any matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted. Unless the area has been closely pastured, it shall be closely mowed and raked to remove all weeds and long-standing stems.

B. Care shall be taken at all times to retain the native soils on the roots of the sod during the process of excavation, hauling and planting. Sod material shall be kept moist from the time it is dug, until planted. When so directed by the Engineer, the sod existing at the source shall be watered to the extent required, prior to excavating. Do not stack sod for more than 36 hours between the time of cutting and the time of installation. The Engineer reserves the right to reject any sod deemed unacceptable for installation.

C. All planting shall be done between the average date of the last freeze in the spring and six weeks prior to the average date for the first freeze in the fall, according to the U.S. Weather Bureau.

D. Fertilizer shall conform to the requirements of SECTION 32 92 23 - FERTILIZER and shall be applied at the rate of 480-pounds per acre.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. Immediately after the finished grade has been approved, begin sodding operations to reduce excessive weed growth. If the sod bed is dry immediately prior to sod installation, dampen the surface with a fine mist of water.

B. Grass shall be turf sod, cut into approximately 18 inch wide by 24-inch long pieces, or 18 inch wide by continuous length rolls.

C. All areas to be sodded shall be raked to true lines, free from all unsightly variations, bumps, ridges or depressions. All sticks, stones, roots or other objectionable material, which might interfere with the formation of a finely pulverized seedbed, shall be removed from the soil.

D. Lay sod so that adjacent strips butt tightly, with no spaces between strips. Lay sod on mounds and slopes, with strips parallel to contours. Stagger joints. Tamp and roll the sod thoroughly to make contact with the sod bed, or as directed by the Engineer.

E. Peg sod on slopes three to one or steeper with pegs driven through sod into soil, until pegs are flush with the turf. Space pegs 18 inches on center. Pegs to be 1 inch square, 6 inches long or, 6-inch lengths of lath. Commercial fertilizer as outlined in SECTION 32 92 23 - FERTILIZER shall be applied to the entire sodded area at the prescribed rates, immediately following laying of the sod. Immediately after fertilizing, water the entire area to a saturated depth of 2-inches.

F. Immediately after installation of the sod, remove sod clumps on soil, wash off any plant materials and pavements not to have sod. Edges along curbs and drives, walkways, etc., shall be carefully trimmed and maintained until accepted.

3.2 CONTRACTOR'S MAINTENANCE AND GUARANTEE PERIOD

A. Maintenance of sodded areas shall be for 60 days after completion of the project and shall consist of watering, weeding, repair of all erosion and resodding as necessary to establish a uniform growth of the specified grass. The Contractor shall guarantee growth and coverage of the sod planted under this contract to the effect that a minimum of 95% of the area planted will be covered with the specified planting after 60 days. Sod panels that are dead or dying shall be replaced.

B. The Contractor shall be responsible for one mowing, in the event that the time between sodding and final acceptance exceeds thirty days.

C. The Contractor shall make a second planting to those bare areas not meeting specified planting as determined by the Engineer. Such replanting is to be performed within 90 days of initial application and upon notification by the Engineer to replant.

END OF SECTION 32 92 23.16

SECTION 33 01 30.13 - SANITARY SEWER TCEQ MANHOLE REQUIREMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

A. This section provides for those TEXAS WATER CODE AMENDMENTS as published in the Texas Register with an ***Effective date of September 1, 2008.*** These requirements are binding for all Sanitary Sewer Manholes.

1.2 SUBMITTALS

A. Submit product data and shop drawings for ALL items to be installed.

B. Refer to Section 01 33 00 for submittal procedures.

1.3 SYSTEM DESCRIPTIONS

A. Design Requirements:
   1. Manholes shall be placed at all points of change in alignment, grade or size of sewer, at the intersection of all sewers and the end of all sewer lines that will be extended at a future date. Any proposal which deviates from this requirement shall be justified to the satisfaction of the TCEQ Executive Director. Clean-outs with watertight plugs may be installed in lieu of manholes at the end of sewers which are not anticipated to be extended. Such installations must pass a leakage test and a deflection test for all flexible lines.

1.4 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manholes shall be monolithic, cast-in-place concrete, fiberglass, precast concrete, HDPE or of equivalent construction as shown on the Plans. Brick manholes shall not be used, nor shall brick be used to adjust manhole covers to grade.

PART 3 - EXECUTION

3.1 CONSTRUCTION DETAILS

A. The maximum required manhole spacing for sewers with straight alignment and uniform grades are in the following table. Reduced manhole spacing may be necessary depending on the utility's ability to maintain its sewer lines. Areas subject to flooding require special consideration to minimize inflow.

Pipe Diameter (inches)	Maximum Manhole Spacing (feet)
6 - 15	500
18 - 30	800

36 - 48	1000
54 or larger	2000

B. Watertight, size-on-size resilient connectors allowing for differential settlement shall be used to connect pipe to manholes. Pipe to manhole connectors shall conform to ASTM C-923. Other types of connectors may be used when approved by the TCEQ. Manholes should not allow surface water to drain into them. If manholes are located within the 100-year flood plain, the manhole covers shall have gaskets and be bolted or have another means of preventing inflow. Where gasketed manhole covers are required for more than three manholes in sequence, an alternate means of venting shall be provided at less than 1500 foot intervals. Vents should be designed to minimize inflow. Impervious material should be utilized for manhole construction in these areas in order to minimize infiltration.

C. Diameter
   1. Manholes shall be sufficient inside diameter to allow personnel to work within them and to allow proper joining of the sewer pipes in the manhole wall. The inside diameter of manholes shall be not less than 48 inches.

D. Inverts
   1. The bottom of the manhole shall be provided with a "U" shaped channel that is as much as possible a smooth continuation of the inlet and outlet pipes. For manholes connected to pipes less than 15 inches in diameter the channel depth shall be at least half the largest pipe diameter. For manholes connected to pipes 15 to 24 inches in diameter the channel depth shall be at least three fourths the largest pipe diameter. For manholes connected to pipes greater than 24 inches in diameter the channel depth shall be at least equal to the largest pipe diameter. In manholes with pipes of different sizes, the tops of the pipes shall be placed at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe. The bench provided above the channel shall be sloped at a minimum of 0.5 inches per foot. Where sewer lines enter the manhole higher than 24 inches above the manhole invert, the invert shall be filleted to prevent solids deposition. A drop pipe should be provided for a sewer entering a manhole more than 30 inches above the invert.

E. Covers
   1. Manhole covers of nominal 30-inch or larger diameter are to be used for all sewer manholes.

F. Access
   1. Design of features for entering manholes shall be guided by the following criteria.
      a. It is suggested that entrance into manholes in excess of four feet deep be accomplished by means of a portable ladder. Other designs for ingress and egress should be given careful evaluation considering the safety hazards associated with the use of manhole steps under certain conditions.
      b. Where steps are used, they shall be made of a non-corrosive material and be in accordance with applicable OSHA specifications as published by the United States Department of Labor.

3.2 TESTING

A. Manholes shall be tested for leakage separately and independently of the wastewater lines by hydrostatic exfiltration testing, vacuum testing, or other methods acceptable to the Commission. If a manhole fails a leakage test, the manhole must be made watertight and retested. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. Alternative test methods must ensure compliance with the above allowable leakage. Hydrostatic exfiltration testing shall be performed as follows: all wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one hour. For concrete manholes a wetting period of 24 hours may be

used prior to testing in order to allow saturation of the concrete.

B. Procedure for Vacuum Testing
1. Vacuum test according to ASTM C 1244, latest edition.
2. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.
3. A vacuum of 10 in. of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop from 10 in. to 9 in. of mercury.
4. The manhole shall be considered as passing if the time for the vacuum reading to drop from 10 in. of mercury to 9 in. of mercury meets or exceeds the values indicated in Table 1.
5. If the manhole fails the initial test, necessary repairs shall be made by a method approved by The Engineer. The manhole shall then be retested until a passing test is obtained.
6. Use or failure of this vacuum test shall not preclude acceptance of the manhole by appropriate water exfiltration testing, or other preapproved means and methods.

TABLE 1 - MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS

Depth (Feet)	Diameter (in.)								
	30	33	36	42	48	54	60	66	72
	Time (sec.)								
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	45	51	57
16	22	24	30	34	40	45	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

END OF SECTION 33 01 30.13

SECTION 33 11 00 - WATER DISTRIBUTION SYSTEM (PVC)

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

A. These specifications shall govern the furnishing and placing of water distribution lines, fittings, valves, fire hydrants, and other appurtenances. The pipe and accessories shall be installed in accordance with the requirements of these specifications at the locations and depths indicated on the plans, and shall be of the classes, sizes and dimensions shown thereon. The installation of pipe shall include all joints, connections to new or existing pipes, and installation of all fittings, valves, fire hydrants, and appurtenances.

1.2 GENERAL

A. Piping for water mains shall be of the type and materials specified herein, at the Contractor's option, unless otherwise indicated on the drawings or in this section. The pipe and accessories shall be new and unused. The interior of the pipe shall be thoroughly cleaned of foreign matters before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells and joints. Any pipe that has the grade or joint disturbed after laying shall be taken up and re-laid. Pipe shall not be laid in water, or when trench or weather are unsuitable for the work. Water shall be kept out of the trench until the jointing is complete. When work is not in progress, open ends or pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipes or fittings. Any section of pipe found to be defective before or after laying shall be replaced with sound pipe without additional expense to the Owner.

1.3 SUBMITTALS

A. Submit product data and shop drawings for ALL items to be installed.

B. Refer to Section 01 33 00 for submittal procedures.

1.4 WATER LINE - SANITARY SEWER LINE CROSSINGS

A. The water pipe shall not be laid closer horizontally than 9 feet in all directions and parallel lines must be installed in separate trenches. Where the nine-foot separation distance cannot be achieved, the following shall apply. The sewer line need not be disturbed where the water line shall be installed parallel to an existing sewer line that shows no evidence of leakage and the water line is installed above the sewer line a minimum of two feet vertically and four feet horizontally. Should excavation for the water line produce evidence that the sewer is leaking, the sewer line shall be replaced as described in SECTION 33 33 13 - SANITARY SEWER LINES. The sewer line shall not be disturbed where a new water line is to cross over (by two feet or more) existing sewer lines showing no evidence of leakage.

1.5 METHOD OF MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All pipe shall be new and made in the United States. All plastic pipe must also bear the National Sanitation Foundation Seal of Approval (NSF-PW) and have an ASTM design pressure rating of at least 150 psi or a standard dimension ratio of 26 or less. Water Distribution Lines must be installed in accordance with the manufacturer's instructions. All water Line materials and appurtenances shall comply with Section 290.44(b) of the Texas Natural Resource Conservation Commission Rules and Regulations for Public Water Systems regarding lead banned from piping and joints.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

A. Requirements for unplasticized polyvinyl chloride (PVC) pipe with bell joints which are integral to the pipe and are well thickened so that standard dimension ratios are maintained or exceeded.

B. Plastic pipe in 4" and larger sizes shall conform to all requirements of AWWA C900 - DR 18, Class 150.

C. Plastic pipe in 2", 2 1/2" and 3" sizes shall conform to all requirements of ASTM D 2241 for PVC pipe and be pressure rated at 200 psi with a standard dimension ratio (SDR) of 21 for Class 200 for both barrel and bell dimensions.

D. Plastic pipe in sizes smaller than 2" shall conform to all requirements of Schedule 40 and have Schedule 80 fittings.

2.3 COPPER TUBING

A. All 3/4", 1", 1-1/2" and 2" copper tubes for underground service shall Be Type "K" soft annealed with the proper bending temper. All 3/4" And 1" tubes shall be furnished in coils, each containing 60 feet; FLAT coils are preferred. Other diameters of tubes shall be furnished in straight lengths of 20 feet.

2.4 BRASS FITTINGS

A. All brass fittings shall conform to ASTM Specifications B-62- 52 And shall be those manufactured by the Mueller Company or preapproved equivalent.

2.5 FITTINGS

A. All fittings shall be cast iron or ductile iron and shall conform to the latest edition of AWWA Specifications.

B. All ductile iron fittings shall be coated outside with a bituminous coating of either coal tar or asphalt. The inside coating shall be a cement-mortar lining in accordance with AWWA Specification.

C. All fittings shall be new and made in the United States.

D. All ductile iron fittings shall be approved by Underwriters Laboratories and shall be accepted by the State Fire Insurance Commission for use in city water distribution systems without penalty.

E. Rubber gaskets for these fittings shall be manufactured in accordance with AWWA specifications.

2.6 GATE VALVES

A. All gate valves shall be designed for a cold hydrostatic working pressure of 175 pounds per square inch for valves with diameters of 3-12 inches, inclusive with shop test of 300 pounds per square inch and a working pressure of 150 pounds per square inch for valves with diameters of 16-48 inches, inclusive with shop test to 300 pounds per square inch. All gate valves shall conform to the requirements of AWWA C500-86 Specification. Valves will be equipped with O-ring stem seals.

B. Gate valves shall be iron body, *resilient seated*, non-rising stem conforming to the requirements of AWWA C509-87 and shall open counter-clockwise. Tapping valves shall be flanged to fit a tapping sleeve on one side and shall be mechanical joint on the other side, with provisions for attaching a standard tapping machine. Gate Valves, fourteen (14) inches and smaller, shall be designed for vertical installation; gate valves, sixteen (16) inches and larger, shall be designed for operation with the stem horizontal or vertical as shown on the plans. Horizontal valves shall be provided with enclosed lubricated bevel gears, bronze gate roller and tracks, bypass valve, and two (2) inch operating nuts on main and bypass valves. Vertically mounted valves sixteen (16) inches and larger shall be designed for operation with the stem vertical and shall be provided with enclosed lubricated spur gears, bypass valve and two (2) inch operating nuts on main and bypass valves. Valves in two (2) inch cast iron screw joint pipe may be two and one-half (2-1/2) inches brass, non-rising stem, wedge disc with thread hubs. Gate valves shall be Mueller, Stockham, M & H or a preapproved equivalent.

C. Unless otherwise specified, all gate valves shall be installed complete with valve box.

2.7 FIRE HYDRANTS

A. Fire hydrants shall be Mueller Super Centurion or an approved equivalent.

B. Each hydrant shall be factory tested to a hydrostatic pressure of 300 psi with valve in both the open and closed positions. The direction of opening nut shall be counterclockwise and shall be cast on the head of the hydrant. Hose nozzles shall be bronze or non-corrosive metal and threads shall be national standard. The main valve opening shall be either five and one-fourth (5-1/4) inches in diameter or six and one-fourth caps shall be provided with gaskets. Bury length shall be three and one-half (3-1/2) feet unless otherwise noted on the plans. Hydrants shall be provided with "dry top" which prevents stem threads from contacting water, and "break-off" type barrel and stem.

C. Hydrants shall be painted with shop coating in accordance with AWWA C502 specification. Final coats of paint will be applied by Contractor in accordance with fire department requirements.

D. Contractor shall verify and make nozzle threads consistent with local fire department.

2.8 AIR VALVES

A. Air valves shall be of the type indicated on the plans. The assembly shall not leak nor shall the valve stick under service conditions.

2.9 CORPORATION COCKS

A. Corporation cocks shall be of the size specified on the plans. Inlet threads shall be Mueller thread or approved equal. Outlet threads shall be one size larger than listed cock size. Corporation cocks shall be Mueller, H-15000 or a preapproved equivalent.

2.10 VALVE BOXES

A. Valve boxes shall be cast iron, adjustable height with cover marked "water". Valve boxes shall be Alamo Iron Works #813-30 or a preapproved equivalent.

2.11 WATER METERS

A. Water meters shall conform to the requirements of AWWA C700, latest revision and shall be of the displacement type. Case shall be bronze, and the register shall be sealed. Accuracy shall be at least 100% plus or minus 1.5% of actual through put. Maximum operating pressure shall be 150 psi. Unless noted otherwise, meters shall be as manufactured by Sensus Technologies, Inc. or a preapproved equivalent.

B. Boxes for water meters shall be of a key-lock type.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. Unless otherwise specified, the provisions of this section shall conform to AWWA C600-64 specifications.

3.2 LAYING AND JOINTING

A. Pipe, fittings, valves, and hydrants shall be carefully handled to avoid damage. While they are suspended over the trench, before lowering, they shall be inspected for defects and rung with a light hammer to detect cracks. To ensure proper seating for the spigot and against the shoulders of the bell, each joint shall be lightly swung against the last joint laid before unhooking the sling. Joints of small diameter pipe, installed by hand, shall be properly seated by using an iron bar or other suitable lever to force the spigot end against the shoulders of the bell of the last previously laid joint. Before any pipe is laid, all dirt shall be removed from the inside, and all lumps, blisters, excess tar coat, dirt, oil, grease, and moisture shall be removed from inside the bell and from outside the spigot end. All pipe shall be laid and maintained to the lines and grades shown on the plans or as established on the ground by the Engineer. Wherever it is necessary to deflect pipe from a straight line, the degree of deflection at each joint shall not exceed the maximum deflection recommended by the manufacturers of the pipe being laid. Bell ends shall face the direction of laying. After pipe is laid, care shall be taken to avoid the entrance of dirt, water or other substances by the use of tight bulkheads or plugs.

B. Gasket material shall be kept in clean containers and shall not be allowed to come in contact with the ground. Gasket material which has become contaminated or dirty shall be destroyed.

C. Mechanical joints shall be installed in accordance with the manufacturer's recommendations.

D. Unless otherwise shown, valves shall be located on the extension of street property line. Every valve, including bypass valves, shall be provided with a valve box. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the cover flush with the pavement surface or such other level as directed.

E. Hydrants shall be located as shown on the Plans and in a manner that will provide complete accessibility and will prevent damage from vehicles. All hydrants shall stand plumb and shall have their pumper connections at right angles to the street. When placed immediately behind the curb, the hydrant barrel shall be set so that no portion of the steamer or hose connection cap will be less than six (6) inches from the gutter face of the curb.

F. Minimum cover on water lines shall be forty-eight (48) inches unless otherwise specified, but in no case shall the top of any water line be less than 24 inches below the finished ground surface.

3.3 EXCAVATION

A. All excavations are to be by the open-trench method, unless the Engineer orders that certain sections of the mains are to be laid in tunnels or bored.

B. The minimum width of the bottom of the trench shall be such that there will be six inches space on each side between the pipe and the walls of the trench. The width of the trench at the surface is not to be less than at the bottom.

C. When excavating machinery is being used, the same shall cut the trench to a grade slightly higher than the bury indicated by the proposal and the trench shall then be fine graded.

D. The trench must always be opened and excavated to the finished grade for a distance of at least 50 feet in advance of the last made-up joint. Water mains into which the mains under construction are to be connected must be located well in advance of such connection to allow for possible adjustment of alignment and/or grade.

E. Bell holes must be excavated in advance of placing the pipe. Materials used shall be placed at locations so as not to interfere unnecessarily with the use of the streets by the public, and not more than two streets intersections shall be closed at any time. The street surface along the line of the trench must be kept free of surplus spoil.

F. The expense of restoring the original condition of improved property in connection with grass, shrubs or any other improvements must be borne by the Contractor. All trees adjacent to the trench must be protected and the trees on public or private property must not be cut unless permission, in writing, is granted.

3.4 BEDDING

A. Sand bedding shall be as shown on the Plans with a minimum compacted depth of six inches.

3.5 ROCK EXCAVATION

A. No rock is anticipated, and no extra compensation will be allowed for rock excavation.

3.6 JACKING, BORING & TUNNELING

A. This item shall govern for the furnishing and installation of pipe by the methods of jacking, boring or tunneling as shown on the Plans and in conformity with this Specification.

B. Pipe shall be of the size, type, and class specified on the Plans, or other types as may be specified by the Engineer or designated on the Plans.

C. Jacking: If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner satisfactory to the Engineer to prevent earth caving.

D. Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking or boring methods, construction shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer, until such time as the backfill has been completed and then shall be removed from the site.

E. Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides, properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided.

F. The Contractor shall furnish for the Engineer's approval, a plan showing his proposed method of handling, including the design for the jacking head, jacking support of back stop, arrangement and position of jacks, pipe guides, etc., complete in assembled position. The approval of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.

G. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than two inches (2") may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two feet (2') in any case. This distance shall be decreased on instructions from the Engineer, if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.

H. The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one inch (1") in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans. If the Contractor desires, he may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping back onto pipe.

I. When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment.

J. Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense.

K. The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.

L. Boring: The boring shall proceed from a pit provided for the boring equipment and workmen. Excavation for pits and installation of shoring shall be as outlined above under "Jacking". The location of the pit shall meet the approval of the Engineer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method approximately a two-inch (2") pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit.

M. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Jetting will not be permitted.

N. In unconsolidated soil formations a gel-forming colloidal drilling fluid consisting of at least 10% of high grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the

pipe immediately thereafter.

O. Allowable variation from line and grade shall be as specified under "Jacking". Overcutting in excess of one inch (1") shall be remedied by pressure grouting the entire length of the installation.

P. Tunneling: Where the characteristics of the soil or the size of the proposed pipe would make the use of tunneling more satisfactory than jacking or boring, or where called for on the Plans, a tunneling method may be used.

Q. The excavation for pits and the installation of shoring shall be as outlined above under "Jacking".

R. The lining of the tunnel shall be of steel of sufficient strength to support the overburden. The Contractor shall submit his proposed liner method to the Engineer for review. Review by the Engineer shall not relieve the Contractor of the responsibility for the adequacy of the liner method.

S. The space between the liner plate and the limits of excavation shall be pressure-grouted or mud-jacked.

T. Access holes for pouring concrete shall be spaced at maximum intervals of ten feet.

U. If corrugated galvanized metal pipe is used, joints may be made by field bolting or by connecting bands, whichever is feasible.

V. Clean-up: Contractor's equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.

W. The Owner shall have the right to make connections with and operate all or any part of the main when, in the opinion of the Engineer, such connection does not in any way interfere with the progress of the work, but it is understood that by making such use or connections the Owner does not accept the sewer or waive his right to object to any defect found therein, until the same has been finally inspected by the Engineer and found to be in accordance with the specifications.

3.7 CROSSING STATE HIGHWAYS AND RAILROADS

A. When water lines cross highways, railroads, or town streets under the jurisdiction of the TxDOT or other public body or corporation, the Contractor shall secure permission from the controlling authority before installing such lines.

3.8 WET CONNECTIONS

A. Wet connections are defined as connections made to a line in the existing system by interrupting water service. They shall be made at such points as are shown on the plans or as designated by the Engineer. The method and the equipment to be used shall be submitted to the Engineer for approval before any work is done.

B. Any time that the interruption of water service in the existing system is necessary because of operations under this contract, the Contractor shall notify the City Water Superintendent forty-eight (48) hours in advance. The Contractor will not operate any valve in the existing water system.

3.9 LOWERING OF EXISTING MAINS

A. When a main is to be lowered in order to conform with new construction, the initial excavation shall be done in such a manner as to permit the mains to rest on several dirt benches, or wooden blocks if soil conditions are unsatisfactory for the benches. The pipe shall then be supported by ropes, cables or chains to overhead supports; the dirt benches or wooden block removed, and the pipe

slowly and evenly lowered into position. After the mains have been lowered, each damaged joint must be re-tightened as directed by the Engineer.

3.10 REMOVING PIPE

A. Salvageable joint materials from each joint of the pipe must be removed and reclaimed for the Owner and all corporation cocks disconnected and the holes plugged with plugs furnished by the Owner before the pipe is raised from its original position. After raising the pipe from the trench, it shall be pulled apart at the joints and all foreign material removed from the bells and spigots.

B. All removed materials are to remain the property of the Owner and shall be hauled to the Owner's storage yard.

C. The unit bid prices for removing mains shall include the removal, the cleaning of exterior and connection surface and hauling to designated storage yards, of all fittings, valves, flushing valves, and other appurtenances.

3.11 TRENCH BACKFILL

A. All trench backfill above pipe embedment shall conform to the following requirements:

B. Tamped backfill placed in six-inch (6") layers and compacted to 95% density will be required for the full depth of the trench beneath pavement, surfacing, driveways, curbs, gutters, walks, or other surface construction or structures as well as beneath street, road, or highway shoulders.

C. In areas other than that described above, backfill shall be placed and tamped in six inch (6") layers until one foot above top of the pipe, then the balance of the backfill shall be placed in twelve inch (12") layers with Compaction approximately equal to that of the adjacent undisturbed material. To compensate for settlement below surface grade backfill material shall be added as necessary and compacted.

3.12 SURPLUS EARTH

A. Any surplus excavated material shall be disposed of as directed by the Engineer. If the Engineer notifies the Contractor that the Owner does not have use for this material, it shall become the property of the Contractor to dispose of as he wishes without injury to the Owner or any individual.

3.13 STREET SURFACES

A. In all streets the surface of the trenches after being refilled, dried and settled, shall be finished in the most workmanlike manner without needless delay and shall in every respect be equal in quality, character, material and workmanship to the street improvements existing over the line of the trench immediately prior to making the excavation. The expense of restoring the streets must be included in the price bid per linear foot for mains, except as otherwise provided herein.

B. All concrete paving, road gravel, and road shell ordered placed on streets will be paid for at the unit price bid.

C. On gravel, shell and asphalt surfaced streets, the trench shall be filled as otherwise specified up to within eight inches of the surface of the street. The trench shall then be filled with gravel or shell, as ordered by the Engineer, to a point approximately one (1) inch higher than the street level. After all other work is completed and before the job is finally accepted, the Contractor shall go back and place such additional gravel or shell as is ordered by the Engineer. No extra payment for road gravel or stabilized shell.

D. On concrete streets the trenches shall be filled as otherwise specified within six (6) inches of the

surface of the street, and then filled with road gravel or shell to a point approximately one (1) inch higher than the street level. After all other work is completed, the Contractor shall go back and remove sufficient shell and install six (6) inches of concrete as ordered by the Engineer. The concrete used shall be paid for at the unit price bid in the proposal schedules.

E. On asphalt surfaced streets, the gravel or shell base shall be placed as stated above. At such time as directed by the Engineer, the gravel or shell base shall be leveled smooth approximately one (1) inch below the existing asphalt surface. The new asphalt pavement shall then be placed and rolled or tamped to a smooth and even surface.

3.14 CROSSINGS TO BE KEPT OPEN

A. At such street crossings and other intermediate points as may be designated by the Engineer, the trenches shall be bridged in such proper and secure manner as to prevent any serious interruption of travel upon the roadway and sidewalks, the cost thereof to be borne by the Contractor.

B. Clean Up: Contractors equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.

C. Laying Pipe: In general, the bottom of the trench shall be shaped to give full support to the lower quarter of each pipe. If the foundation is rock or other hard material, a bed of sand or suitable earth shall be placed upon the subgrade and well compacted. The thickness of the bed shall be not less than two (2) inches nor more than six (6) inches. If the foundation is of such material or if conditions are such that the pipe cannot be otherwise properly supported or if the load on the pipe so requires, a concrete cradle as hereinafter specified shall be provided. In all cases water shall be kept out of the trench until the masonry or jointing material has sufficiently hardened. The pipe shall be laid to grade shown on the plans or as directed by the Engineer. Each pipe shall be inspected for defects prior to being lowered into the trench and shall be carefully cleaned in both bell and spigot. Pipe laying shall proceed up-grade with spigot ends pointing in direction of flow. Pipes shall be laid so that each pipe shall rest upon the full length of its barrel with holes excavated to accommodate bells. Except by special permission, no pipe shall be laid except in the presence of an inspector. Any defective pipe laid or any pipe which has had its grade of joint disturbed after laying shall be taken up and replaced.

D. Before joining the inside of the bells and outside of the spigots shall be dry and clean. The joint shall be made as recommended by the manufacturer of the joint material. Water shall not be allowed in the trenches while the pipes are being laid. The Contractor shall not open up more trenches than the available pumping facilities are able to de-water, to the satisfaction of the Engineer. Bells shall be entirely free of water when joints are made, regardless of the type of joint, and no water shall be allowed to rise over the joint until it has set.

3.15 HOUSE CONNECTIONS

A. House connections to main pipe shall be made by tapping the main and installed corporation cock of the size designated. The corporation cock shall be screwed securely into position. The copper service, polyethylene or butylene pipe shall be connected to the corporation cock and laid in accordance with the specifications contained herein for laying pipe.

3.16 INSTALLING WATER METERS AND METER BOXES

A. Water Meters: The ground shall be excavated to such depth that the top of the box is flush with normal ground level. The tail piece of the meter shall be inserted into the service lines as near to the curb cock as possible, or directly into the curb cock. The meter shall then be set in such position that the bottom of the meter is at least two (2) inches above ground. The house side of the meter shall then be connected to the service line running to the house. It is essential that the meters shall

be set plumb and in line with the service line and all connections made in a neat and workmanlike manner.

B. Meter Boxes: The meter box shall be set on firm ground so that the top of the meter box is flush with the ground surface, and the box is level and plumb. Ground shall be carefully backfield and tamped around the meter box to leave a neat appearance.

3.17 SETTING FIRE HYDRANTS

A. Fire hydrants shall be set where shown on the plans or ordered by the Engineer.

B. Excavate underneath the drain outlet of each fire hydrant a space twelve (12) inches square and six (6) inches deep and fill with gravel. Place the gravel up around bottom of the flushing hydrant not less than three (3) inches above the drain outlet. Not less than two (2) cubic feet of gravel shall be placed around each flushing hydrant. The gravel shall be carefully covered with a layer of one ply roofing paper before trench around the hydrant is refilled. All hydrants shall be carefully blocked and placed to prevent expansion of stub line from water pressure. See plan sheet for blocking details.

3.18 STERILIZATION OF PIPELINES

A. Unless otherwise specified, sterilization of new water lines shall be done in accordance with AWWA C651-86 specification.

B. The contractor shall furnish all labor equipment, and materials necessary for the sterilization of the new pipelines, which shall be sterilized before being tested and placed in service. The lines shall be sterilized by the application of a chlorinating agent. The chlorinating agent may be liquid chlorine, liquid chlorine gas-water mixture, or a calcium hypochlorite solution, which shall be fed into the lines through a suitable solution-feed device or other methods approved by Engineer. The chlorinating agent shall be applied at or near the point from which the line is being filled, and through a corporation stop or other approved connection inserted in the horizontal axis of the newly laid pipe. The water being used to fill the line shall be controlled to flow into the section to be sterilized very slowly, and the rate of water entering the pipe that the chlorine dose applied to the water entering the line shall be a minimum of 50 ppm of chlorine residual of not less than twenty five (25) ppm after twenty-four (24) hours standing in the pipe. At the end of the retention period, all treated water shall be thoroughly flushed from the lines until the replacement water in the lines shall have a chlorine residual of not more than 0.4 parts per million.

C. Solvent cemented or welded joint pipes shall be sterilized using a sterilizing agent other than liquid chlorine and/or calcium hydrochloride.

D. Where no suitable outlet is available for flushing dead ends, the Contractor shall furnish and install outlet valves of sufficient size to adequately flush the new mains at the locations designated by the Engineer, for which payment shall be made at the unit price bid for the size valve installed. After the lines are sterilized and flushed and tested as specified above, samples of water shall be taken from the mains for bacteriological tests. If the samples fail to meet the health departments standard requirements, the disinfection process as outlined above shall be repeated and continued until the tests show results that meet the health departments requirements.

3.19 HYDROSTATIC TEST

A. The Contractor shall provide all necessary equipment and shall perform all work required in connection with the tests. All pressure pipe installations shall be tested for leakage in the presence of the Engineer. The Engineer shall be given a minimum of 24 hours' notice for each and every test. Tests that are not performed in the presence of the Engineer will not be accepted.

B. The test pressure shall be 1.5 times the maximum force main design pressure or 150 pounds per square inch gauge, whichever is greater. The test shall be held for a period of four (4) hours. The new system shall be tested in sections between valves. The length of test sections shall not exceed 2,000 feet unless authorized by the Engineer. Each test section shall be slowly filled with water, care taken to expel all air from the pipe. If necessary, the pipes shall be tapped at high points to vent the air. There will be no extra charge to the Owner for venting.

C. At the end of the test period, the amount of leakage shall be determined by the quantity of water that must be supplied into the pipe, or any valved section thereof, to maintain pressure within five pounds per square inch of the specified test pressure, after the air in the pipe has been expelled. The maximum allowable leakage shall be calculated using the following formula.
   1. L = SD((P)^(1/2))/133,200, where L = leakage in gal/hr
   2. S = length of pipe in feet
   3. D = inside diameter of pipe in inches
   4. P = pressure in pounds per square inch

D. If the quantity of leakage exceeds the maximum amount calculated, the failed section will be rejected and not accepted until it meets the above requirements.

E. Upon completion of all sterilization and testing, the Contractor shall provide personnel to open all valves and operate all hydrants, as directed, in the presence of a representative of the Engineer.

END OF SECTION 33 11 00

SECTION 33 33 13 - SANITARY SEWER LINES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Work under this Section includes furnishing all plant, labor, materials, equipment, tools, incidentals and the performance of all work necessary to complete all sanitary sewers and appurtenances, as shown on the drawings and herein specified including the following:
   1. Sanitary Sewers
   2. Sanitary Sewer Manholes and Cleanouts
   3. Service Connections
   4. Force Main

1.2 SUBMITTALS

A. Submit product data and shop drawings for ALL items to be installed.

B. Refer to Section 01 33 00 for submittal procedures.

1.3 METHOD OF PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Sanitary sewer pipe shall be one or any of the following materials or any combination as required by the Plans.
   1. PVC
      a. Polyvinyl Chloride (PVC) Pipe for Pressure Rated Lines shall be of the best quality, push-on type, with factory pre-molded gasketed joints. Pipe shall conform to ASTM D-2241 for PVC pipe.
      b. PVC pipe for gravity sewer should be of the best quality, bell and spigot, with factory pre-molded gasketed joints. Pipe shall conform to ASTM D-3034, SDR 26, for PVC pipe, unless otherwise noted on the plans. All PVC pipe shall be manufactured from Cell Class 12454B in accordance with ASTM D-1784.

   2. Ductile Iron Pipe
      a. Ductile Iron Pipe shall be designed in accordance with ANSI Standard A21.50 (AWWA C-151), or the latest revision thereof. Ductile iron pipe shall be thickness Class 50, pressure rated for 150 PSI unless otherwise indicated on the plans or in the Special Provisions of the Specifications. Pipe and fittings shall be lined with 20 mils of epoxy. Extend lining from plain or beveled end to rear of gasket socket.
      b. The exterior of the pipe shall have a bituminous coating approximately one mil in thickness.
      c. Polyethylene encasement for use on ductile iron pipe and fittings shall be eight (8) mils thick and conform to the latest revision of ANSI Specification A21.5 (AWWA C-105). All pipe, fittings and appurtenances shall be Polyethylene encased.

d. Polyethylene encasement shall be installed in accordance with the latest revision of ANSI 21.5 (AWWA C-105) standard and shall prevent contact between the buried pipe and appurtenances and the surrounding backfill and bedding material but is not intended to be a completely air and watertight enclosure. Overlaps shall be secured by use of adhesive polyethylene tape, plastic string, binder twine or any other material capable of holding the encasement in place until the backfilling operations are completed.

e. Pipe shall be encased in polyethylene tubes with sheets being used in irregular shapes if the tube is not adaptable.

3. Centrifugally Cast Fiber Glass Pipe

a. Centrifugally Cast Fiber Glass Pipe, joints and fittings supplied under this specification shall, as a minimum, conform to the requirements of AWWA C950-81, AWWA Standard for Glass-Fiber Reinforced Thermosetting-Resin Pressure Pipe and ASTM D3517, Standard Specification for Reinforced Plastic Mortar Pressure Pipe, in the case of pressure pipes, and ASTM D3262, Standard Specification for Reinforced Plastic Mortar Sewer Pipe, in the case of gravity sewer pipes. Prior to manufacturing, the pipe supplier shall provide the Engineer with independent laboratory test reports certifying that the pipe has been tested in accordance with and exceeds all minimum requirements of ASTM D-2992 and ASTM D-3681. Manufacturer's "in house" test reports will not be acceptable as a substitute for independent laboratory testing.

b. The Manufacturer shall use only approved polyester resin systems for which he can provide a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.

c. The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade of glass filaments with binder and sizing compatible with impregnating resins.

d. Silica sand or other suitable materials may be used.

e. Resin additives, such as pigments, dyes, and other coloring agents, if used, shall in no way be detrimental to the performance of the product nor shall they impair visual inspection of the finished product.

B. Joints

1. PVC

a. PVC Pipe bell and spigot joints shall be factory pre-molded, compression type joints of elastomeric material.

b. The integral bell gasketed joint shall be designed so that when assembled, the elastomeric gasket inside the bell is compressed radially on the pipe spigot to form a positive seal. The joint shall be so designed to avoid displacement of the gasket when installed in accordance with the manufacturer's recommendation. The joints shall conform to ASTM D-3212 specification standards.

c. All gaskets shall be molded into a circular form and extruded to the proper section and then sliced into circular form and shall consist of a properly vulcanized high-grade elastomeric compound.

d. The basic polymer shall be natural rubber, synthetic elastomer or a blend of both, and meeting the physical requirements prescribed within this specification. The gasket shall provide an adequate compressive force so as to affect a positive seal under all combinations of joint tolerances. The gasket shall be the only element depended upon to make the joint flexible and watertight. The gaskets shall conform to ASTM F-477 specification standards.

2. Ductile Iron Pipe

a. Ductile Iron Pipe and Fittings Push-on joints shall conform to ANSI Standard A21.11, Section 11-2.3 (AWWA C-111 Section 11-2.3) the latest revision thereof.

All required lubricant shall be included with the pipe and/or fittings. These joints shall be used for underground installation of the sewer.

b. Mechanical joints shall conform to ANSI Standards A21.10 and A21.11 latest revision. All required lubricant shall be included. These joints shall be used for underground installation. Bolts underground shall be cadmium plated.

c. Flanged joints for pipe shall conform to ANSI Standard A21.15 (AWWA C-115) the latest revision thereof. Flanges shall be class 125 drilled and faced in accordance with ANSI Standard B16.1. Required nuts, bolts and gaskets are to be included with Pipe and/or fittings. These joints shall be used inside structures and above ground installation.

d. Flanged joints that are fabricated by someone other than the pipe manufacturer shall be made from Class 53 pipe to ensure that the wall thickness in the threaded area is not less than that of Class 50 pipe. The OWNER or his authorized representative shall have the right to make periodic inspections of the fabricators shop.

3. Centrifugally Cast Fiber Glass Pipe

a. Centrifugally Cast Fiber Glass Pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing rings as the sole means to maintain joint water-tightness. The joints must meet the performance requirements of ASTM D4161.

b. Flanges, elbows, reducers, tees, wyes, and other fittings shall, when installed, be capable of withstanding all operating conditions. They may be contact molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays. For design pressures of over 150 psi, Type 316 stainless steel fittings or fusion epoxy-coated steel fittings shall be provided.

C. Manholes

1. All manholes shall be constructed, complete with covers, in accordance with the details shown on the Drawings. Manholes shall be constructed of solid precast curved segmental concrete units, circular sections specially cast for use in manhole construction, or of fiberglass reinforced plastic in accordance with the Plans and as approved by the Engineer.

2. Manholes shall be constructed of materials which shall conform to the following:

a. Concrete: As specified in the concrete specification.

b. Segmental Concrete: ASTM C 139, except as modified herein.

c. Circular Precast Sections: ASTM C 478

d. Castings:

1) Iron: ASTM A 48

2) Coating: Hot Asphaltum varnish applied at the foundry.

e. Fiberglass: Heavy wall, Owens-Corning Fiberglas or L.F. Manufacturing, Inc. Provide "O" ring for all pipe connections. The concrete base for a standard 48-inch diameter fiberglass manhole shall be a minimum of 6'x 6'x 15" thick with #5 bars at 12" on center each way. Backfill with bank sand or approved equivalent in 12" maximum lifts. Compact each lift to 95% standard proctor density.

f. All manholes shall have stainless steel manhole inserts (inflow preventers) installed under the manhole covers to prevent infiltration.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. Laying Pipe

1. Pipe shall be protected from lateral displacement by means of pipe embedment material installed as provided in the trench backfill specification. Under no circumstances shall pipe

be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.

2. When jointed in the trench, the pipe shall form a true and smooth line. Pipe shall not be trimmed except for closures, and pipe not making a good fit shall be removed. Permissible defects shall be placed in the top of the pipe.
3. Unless otherwise approved by the Engineer, the laying of pipe shall be begun at the lowest point and the pipe shall be installed so that the spigot ends point in the direction of flow.
4. The installation of all pipes and fittings shall meet the requirements of the manufacturer's published installation instructions. The Manufacturer must supply a suitable qualified field service representative to be present periodically during the installation of the pipes.
5. Alignment and Grade
   a. Unless otherwise shown on the plans, all pipe shall be laid straight between changes in alignment and at a uniform grade between changes in grade. All lines shall be laid so that each section between manholes will lamp.
   b. The Contractor shall erect substantial batter boards at intervals of not more than 50 feet. Batter boards or approved laser light shall be used to determine and check pipe subgrades. Not less than three batter boards shall always be maintained in proper position when trench grading is in progress.

B. Trench Construction
1. All excavated material should be stockpiled in a manner that will not endanger the work. Hydrants under pressure, water and gas valves, manhole covers, fire and police call boxes, or other utility controls should be left unobstructed and accessible until work is completed. Gutters should be kept open, or other satisfactory provisions should be made for street drainage. Natural water courses should not be obstructed. Unless otherwise approved, stockpiles should not obstruct adjacent streets, walks, or driveways.
2. The maximum earth load on flexible pipe (PVC pipe) results from the consolidated prism of earth directly over the width of the pipe. If design load on the pipe is calculated based on embankment conditions (prism), the trench may be excavated to a width which is as wide as is dictated by practical and economical construction.

   Types of construction for various anticipated conditions are described as follows:
   a. **Narrow Unsupported, Vertical-Walled Trench**: The amount of pavement to be removed and replaced and amount of embedment material used may dictate that the most economical installation is the narrow, vertical-walled trench. The width of narrow trenches as determined by the minimum working room for a man to place haunching material should provide a minimum of 18 inches for 4" and 6" size pipes and not more than 6 to 9 inches clearance on each side of the pipe for 8" and larger sizes. In narrow trenches the pipe embedment should be compacted all the way to the trench walls.

NARROW TRENCH WIDTH, MINIMUM

Nominal Pipe Size Inches	No. of Pipe Diameters (O.D.)	Trench Width Minimum
4	4.3	18
6	2.9	18
8	2.9	24
10	2.5	26
12	2.4	30
15	2.0	30

   b. **Unsupported Sub-Ditch Trench**: A Variation of the narrow vertical-walled trench is to lay the pipe in a sub-ditch and back cut or slope the sides of the excavation above the top of the pipe. This type of construction may be permitted where no

inconvenience to the public or damage to property, buildings, subsurface structures, or pavements will result. In such case, the width of the sub-ditch below the top of pipe should be established as shown in "NARROW TRENCH WIDTH" Table.

c. **Wide Trench**: Wide trenches are classified as trenches whose width at the top of the pipe is greater than 2-1/2 pipe diameters on each side of the pipe or a total of 6 pipe diameters. There is no limit to the maximum width of the trench beyond 2-1/2 pipe diameters from the side of the pipe since the maximum earth load on flexible pipe does not exceed the weight of the earth prism directly over the pipe. However, the pipe embedment in wide trenches should be compacted to a point at least 2-1/2 pipe diameters from each side of the pipe.

d. **Supported Trench**: Where an unstable or flowing soil condition is encountered in the trench wall, such as may be found by excavation below ground water or in weak or non-cohesive soils, this condition must be stabilized before laying the pipe. Depending upon the severity of the condition, jacks, a trench shield or box to support the trench during pipe laying operations may be necessary . If the condition is too severe, it may be necessary to leave any sheeting in place or to use chemical or cement grouting of the soil adjacent to the excavation to prevent migration between the material used beneath and around the pipe and trench wall material.

SUPPORTED TRENCH WIDTH, MINIMUM

Nominal Pipe Size (Inches)	No. of Pipe Diameters (O.D.)	Trench Widths, Minimum (Inches)
4	8.5	36
6	5.7	36
8	4.3	36
10	4.0	42
12	3.4	42
15	3.1	48

e. Widths are based upon 8 to 10 inches clearance on each side of the pipe to the inner face of trench supports. The trench supports are assumed to be 6-inch-thick trench box or shield walls of 4-inch wales inside of 2-inch sheeting. Exceptionally deep trenches with thicker sheeting and bracing or other systems of trench support may require variations of these trench widths. Timber sheeting, where used below the top of the pipe, should be driven approximately 2 feet below the bottom of the pipe and be left in place approximately 1.5 feet above the top of pipe. In supported trenches, compaction of foundation and embedment materials should extend to the trench wall or sheeting left in place.

f. **Movable Sheeting, Trench Boxes or Shields**: When using movable trench support, care should be exercised not to disturb the pipe location, jointing or its embedment. Removal of any trench protection below the top or the pipe and within 2-1/2 pipe diameters of each side of the pipe should be prohibited after the pipe embedment has been compacted. For this reason, movable trench supports should only be used in either wide trench construction where supports extend below the top of the pipe or on a shelf above the pipe with the pipe installed in a narrow, vertical-wall sub-ditch. Any voids left in the embedment material by support removal should be carefully filled with granular material which is adequately compacted. Removal of bracing between sheeting should only be done where backfilling proceeds and bracing is removed in a manner that does not relax trench support. When advancing trench boxes or shield, prevent longitudinal pipe movement or disjointing.

3. Dewatering
   a. Where conditions are such that running or standing water occurs in the trench bottom or the soil in the trench bottom displays a "quick" tendency, the water should be removed by pumps and suitable means such as well points or pervious underdrain bedding until the pipe has been installed and the backfill has been placed to a sufficient height to prevent pipe flotation. Care should be taken that any underdrain is of proper gradation and thickness to prevent migration of material between the underdrain, pipe embedment and native soils in the trench below and at the sides of the pipe.

4. Preparation of Trench Bottom
   a. The trench bottom shall be excavated below grade to provide the specified depth of bedding and support for the full length of the pipe. Any part of the trench bottom excavated below grade should be backfilled to grade and should be compacted as required to provide firm pipe support. When an unstable subgrade condition is encountered which will provide inadequate pipe support, additional trench depth should be excavated and refilled with suitable foundation material. In severe conditions special foundations may be required such as wood pile or sheeting capped by a concrete mat, wood sheeting with keyed-in plank foundation, or foundation material processed with cement or chemical. A cushion of acceptable bedding material should always be provided between any special foundation and the pipe. Ledge rock, boulders, and large stone should be removed to provide four inches of soil cushion on all sides of the pipe and accessories.

5. Laying of Pipe
   a. Proper implements, tools, and equipment should be used for placement of the pipe in the trench to prevent damage. Under no circumstances should the pipe or accessories be dropped into the trench.
   b. Pipe bells should be laid on the upstream end. Pipe laying should commence at the lowest elevation and should terminate only at manholes, service branches or clean-outs. All foreign matter or dirt should be removed from the pipe interior. Pipe joints should be assembled with care. Whenever pipe laying is interrupted, the open ends of installed pipe should be closed to prevent entrance of trench water, mud, or foreign matter.

C. Branch Fittings
   1. Fittings for service branches in new construction should be molded or fabricated with all gasketed connections. Taps into existing lines should use a gasketed fitting in conjunction with a repair sleeve coupling or a gasketed saddle wye or tee with all stainless-steel clamps. Saddles may be mounted on pipe with solvent cement or gasket but should be secured by metal banding. Saddles should be installed in accordance with manufacturer's recommendations. Holes for saddle connections should be made by mechanical hole cutters or by keyhole saw or sabre saw. Holes for wye saddles should be laid out with a template and should be de-burred and carefully beveled where required to provide a smooth hole shaped to conform to the fitting. Fittings which are prefabricated using pipe sections, molded saddles and PVC solvent cement may be used, provided the solvent cement used in fabrication has cured at least 24 hours prior to installation. Cemented mitered connections without socket reinforcement should not be used. PVC Primer and solvent cement should be used in accordance with the cement manufacturer's recommendations and ASTM D2855, Making Solvent-Cemented Joints with PVC Pipe and Fittings. After solvent cementing saddles, temporary band clamps should be quickly placed both upstream and downstream of the saddle and tightened.

D. Service Lines
   1. Service Lines from the property line to the collection sewer should be at a minimum depth of 3 feet at the property line and should be laid to straight alignment and uniform slope of not less than 1/4 inch per foot for 4-inch pipe and 1/8 inch per foot for 6-inch pipe. Where collection sewers are deeper than 7 feet a vertical standpipe or stack is required unless otherwise provided for on the Plans. The standpipe or stack does not require concrete encasement; it shall be uniformly supported by compacted backfill.

E. Bedding
   1. Sanitary sewer line bedding and embedment material shall comply with ASTM D-2321, Class I or II.
   2. Bedding is required to bring the trench bottom up to grade. Bedding material should be placed to provide uniform and adequate longitudinal support under the pipe. Blocking should not be used to bring the pipe to grade. Bell holes at each joint should be provided to permit the joint to be assembled properly while maintaining uniform pipe support. A compacted depth of 4 to 6 inches is general sufficient bedding thickness. In trenches which have natural materials of fine grains, and in conditions where migration of trench wall material into bedding material can be anticipated, either wide trench construction or well graded bedding material without voids should be used.
   3. The most important factor affecting pipe performance and deflection is the haunching material and its density. Material should be placed and consolidated under the pipe haunch to provide adequate side support to the pipe while avoiding both vertical and lateral displacement of the pipe from proper alignment. Where coarse materials with voids have been used for bedding, the same coarse material should be used for haunching and consideration shall be given to using wide trench construction. Haunching is placed up to the pipe spring line.

F. Backfill
   1. Initial backfill (pipe embedment) shall be completed to a point at least 12 inches over the top of the pipe utilizing Class I or Class II materials as defined in ASTM D-2321.
   2. All Trench backfill above pipe embedment shall conform to the requirements of Class III material (or better) as defined in ASTM D-2321.
   3. Tamped backfill placed in six-inch (6") layers and compacted to 95% density will be required for the full depth of the trench beneath pavement, surfacing, driveways, curbs, gutters, walks, or other surface construction or structures as well as beneath street, road or highway shoulders.
   4. In areas other than that described above, backfill shall be placed and tamped in six inch (6") layers until one foot above top of the embedment material then the balance of the backfill shall be placed in twelve inch (12") layers with compaction approximately equal to that of the adjacent undisturbed material. To compensate for settlement below surface grade backfill material shall be added as necessary and compacted.
   5. If flooding, jetting or puddling is employed for compaction, care should be taken to prevent drainage and flotation of the pipeline. Saturation should not be used during freezing weather. Erosion of support at the pipe sides and bottom by water jetting should be prevented. Apply only enough water to give complete saturation. Allow time for the saturated soil on each layer to dewater and solidify until it will support the weight of workers.
   6. Take care to avoid contact between the pipe and compaction equipment. Do not use compaction equipment directly over the pipe until sufficient backfill has been placed to ensure that such equipment will not damage or disturb the pipe.
   7. At least 30 inches of cover over the top of the pipe should be provided before the trench is wheel-loaded. At least 48 inches of cover should be provided before using mobile trench compactors of the hydro hammer or impactor type.
   8. Any surplus excavated material shall be disposed of as directed by the Engineer. If the Engineer notifies the Contractor that the Owner does not have use of this material, it shall become the property of the Contractor to dispose of as he wishes without injury to the Owner or any individual.

G. Street Surfaces
1. In all streets the surface of the trenches after being refilled, dried and settled, shall be finished in the most workmanlike manner without needless delay and shall in every respect be equal in quality, character, material and workmanship to the street improvements existing over the line of the trench immediately prior to marking the excavation. The expense of restoring the streets must be included in the price bid per linear foot for mains, unless otherwise provided.
2. On gravel or limestone, surfaced streets, the trench shall be filled as otherwise specified up to within 4 inches of the surface of the street unless otherwise called for on the Plans. The trench shall then be filled with gravel or limestone, as ordered by the Engineer, to a point approximately 1 inch higher than the street level. After all other work is completed and before the job is finally accepted, the Contractor shall go back and place such additional gravel or limestone as ordered by the Engineer.
3. On concrete streets the trenches shall be filled as otherwise specified within 6 inches of the surface of the street unless otherwise call for on the Plans, and then filled with flexible base to a point approximately 1 inch higher than the street level. After all other work is completed, the Contractor shall go back and remove sufficient flexible base and install concrete of the thickness ordered by the Engineer.
4. On asphalt surfaced streets, the gravel or limestone base shall be placed as stated above. At such time as the gravel or limestone base shall be leveled smooth approximately one inch below the existing asphalt surface, the new asphalt pavement shall then be placed and rolled or tamped to a smooth and even surface.

H. Pipe Crossing Trenches
1. Where any pipe crosses a trench, such as sewer pipe, water or gas pipe, having an exposed joint in the trench, and in the opinion of the Engineer the pipe will not safely span the trench without danger of breaking, it must be supported with a reinforced concrete beam constructed in the following manner: A trench under said cross pipe shall be opened up to a point varying from two (2) to six (6) feet back from the sides of the main trench as the Engineer may direct, so that a timber box may be placed around the pipe and supported by two (2) struts, one on each side of the trench, and resting on a plank across the bottom of trench, underneath the line and of such dimensions as is necessary, to properly support the ends of the beam and pipe which it carries. The width of this box shall be twice and the depth, not to exceed 12", shall be three times the outside diameter of the pipe supported. The box shall then be filled with 3000 psi concrete with a sufficient number of bars of reinforcing steel placed one (1) inch above bottom of box extending the entire length thereof, to provide an area of steel equal to one percent of the sectional area of concrete in the beams. The timber used as forms and struts must be left in the trench.
2. Should it become necessary to change the position of such pipe, conduit or structure, the Engineer shall be notified at once of the locality and circumstances and shall thereupon give directions as to what shall be done, and the Contractor shall conform thereto, and shall be paid (upon the estimate of the Engineer) for materials furnished and for the labor performed upon such change, insofar as it may be additional to that contemplated. The Contractor shall be responsible for injuries to persons and property, for all damage to any pipe, conduit, sewer or other structures injuriously affected by the work, and the Owner shall not be liable thereof.

I. Jacking, Boring & Tunneling
1. This item shall govern for the furnishing and installation of pipe by the methods of jacking, boring or tunneling as shown on the Plans and in conformity with this Specification.
2. Pipe shall be of the size, type, and class specified on the Plans, or other types as may be specified by the Engineer or designated on the Plans.
a. Jacking
1) If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting

the jacking operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner satisfactory to the Engineer to prevent earth caving.

2) Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking or boring methods, construction shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer, until such time as the backfill has been completed and then shall be removed from the site.

3) Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides, properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided.

4) The Contractor shall furnish for the Engineer's approval, a plan showing his proposed method of handling, including the design for the jacking head, jacking support of back stop, arrangement and position of jacks, pipe guides, etc., complete in assembled position. The approval of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.

5) The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than two inches (2") may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two feet (2') in any case. This distance shall be decreased on instructions from the Engineer, if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.

6) The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one inch (1") in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans.

7) If the Contractor desires, he may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping back onto pipe.

8) When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment.

9) Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense.

10) The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.

b. Boring

1) The boring shall proceed from a pit provided for the boring equipment and workmen. Excavation for pits and installation of shoring shall be as outlined above under "Jacking". The location of the pit shall meet the approval of the Engineer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method approximately a two-inch (2") pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit.

2) This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Jetting will not be permitted.

3) In unconsolidated soil formations a gel-forming colloidal drilling fluid consisting of at least 10% of high grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the pipe immediately thereafter.

4) Allowable variation from line and grade shall be as specified under "Jacking". Over cutting in excess of one inch (1") shall be remedied by pressure grouting the entire length of the installation.

c. Tunneling

1) Where the characteristics of the soil or the size of the proposed pipe would make the use of tunneling more satisfactory than jacking or boring, or where called for on the Plans, a tunneling method may be used.

2) The excavation for pits and the installation of shoring shall be as outlined above under "Jacking".

3) The lining of the tunnel shall be of steel of sufficient strength to support the overburden. The Contractor shall submit his proposed liner method to the Engineer for review. Review by the Engineer shall not relieve the Contractor of the responsibility for the adequacy of the liner method.

4) The space between the liner plate and the limits of excavation shall be pressure-grouted or mud-jacked.

5) Access holes for pouring concrete shall be spaced at maximum intervals of ten feet.

6) If corrugated galvanized metal pipe is used, joints may be made by field bolting or by connecting bands, whichever is feasible.

J. Clean Up

1. Contractor's equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.

2. The Owner shall have the right to make connections with and operate all or any part of the main when, in the opinion of the Engineer, such connection does not in any way interfere with the progress of the work, but it is understood that by making such use or connections the Owner does not accept the sewer or waive his right to object to any defect found therein, until the same has been finally inspected by the Engineer and found to be in accordance with the specifications.

K. Water Line Crossing

1. **Water line/new sewer line separation**: When new sanitary sewers are installed, they shall be installed no closer to waterlines than nine feet in all directions. Sewers that parallel

waterlines must be installed in separate trenches. Where the nine-foot separation distance cannot be achieved, the following guidelines will apply.

a. Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron, or PVC meeting ASTM specifications with a pressure rating for both the pipe and joints of 150 psi. The vertical separation shall be a minimum of two feet between outside diameters and the horizontal separation shall be a minimum of four feet between outside diameters. The sewer shall be located below the waterline.

b. Where a sanitary sewer crosses a waterline and the sewer is constructed of cast iron, ductile iron, or PVC with a minimum pressure rating of 150 psi an absolute minimum distance of six inches between outside diameters shall be maintained. In addition, the sewer shall be located below the waterline where possible and one length of the sewer pipe must be centered on the waterline.

c. Where a sewer crosses under a waterline and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe, or concrete pipe with gasketed joints, a minimum two-foot separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet of the waterline. This initial backfill shall be from one quarter diameter below the centerline of the pipe to one pipe diameter (but not less than 12 inches) above the top of the pipe.

d. Where a sewer crosses over a waterline, all portions of the sewer within nine feet of the waterline shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at five feet intervals with spacers or be filled to the spring line with washed sand. The encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.

2. **Water Line/manhole separation**: Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet of horizontal clearance from an existing or proposed waterline. Where the nine-foot separation distance cannot be achieved, a carrier pipe may be used where appropriate.

3.2 MANHOLES & CLEANOUTS

A. Manholes

1. Manhole covers shall have the designation "SEWER" on top.
2. All concrete segmental units shall be saturated with water before laying and shall be damp but free from surface water when laid.
3. All mortar shall be used within 40 minutes after mixing. Mortar which has begun to take on initial set shall be discarded and shall not be mixed with additional cement or new mortar. Manhole inverts shall be carefully constructed to maintain the proper velocities through the manhole be greater than that of the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be connected with as large radius of curve as practicable. All inverts shall be troweled to a smooth clean surface.
4. Concrete filling between the sewer invert and walls of manholes shall be flush with top edges of the inverts and slope up from the invert at the rate of 2 inches per foot.
5. Circular precast sections shall be provided with a rubber O-Ring to seal the joints between sections. After the sections are in place, the outside of each joint shall be plastered with cement mortar.
6. Stubs shall be provided in manholes at the locations shown on the plans. Stubs shall be not less than 2.0 feet long and shall terminate in a bell and plug.

7. Manhole installation shall be in strict compliance with the manufacturers recommended installation procedures when precast or pre-molded units are used.
8. Excavation shall be adequate to accommodate the concrete foundation slab and to provide working room around the manhole.
9. Backfilling around manholes shall not begin until concrete base has cured for 24 hours. Backfill using native soil free of foreign objects, stones, concrete, or debris. Backfill in 12-inch layers to avoid uneven loading. Do not allow equipment to impact manholes during backfill operations.
10. Do not backfill above flat areas at top of cone of manholes to allow for installation of concrete chimney.
11. Construct chimneys using precast concrete rings to bring manholes to finished grade.
12. Cast iron for manhole frames and covers shall conform to the dimensions shown on detail drawings and shall be clean, free from sand and blow holes or other defects. Holes in cover must be free from plugs or burrs. Bearing surfaces of frames and covers are to be machined so that even bearing occurs when covers are seated in the frames.
13. Drop manholes shall be constructed where called for in the construction plans and/or where sewer lines enter the manhole higher than 24 inches above the manhole invert. On drop manholes, the invert shall be fitted to prevent solids deposition. A drop pipe should also be provided for a sewer line entering a manhole more than 24 inches above the invert.
14. Cleanouts are required were shown on the plans and on all onsite 6-inch and 4-inch sanitary sewer lines. Spacing shall be every 100ft measured from the upstream entrance of the cleanout.

3.3 SERVICE CONNECTIONS

A. Locate all service connections as shown on Plans and layout with an approved plug. The exact location of all service connections shall be established in the field by Owner's Representative. Contractor shall locate all service connections on his as-built drawings.

B. Stacks shall be provided wherever top of the sewer is 8' - 0" or greater below the surface of the ground. Stacks shall be in accordance with details shown on Drawings.

3.4 TESTS

A. All pipe installations shall be tested in the presence of the Engineer. The Engineer shall be given a minimum of 24 hours' notice for each and every test. Tests that are not performed in the presence of the Engineer will not be accepted.
   1. Low Pressure Air Test
      a. After completing backfill of a section of sewer line the Contractor shall, at his expense, conduct a Line Acceptance Test using low pressure air. The test shall be performed using stated equipment according to the stated procedures and under the observation of the Engineer.

   2. Equipment
      a. The equipment shall meet the following minimum requirements:
         1) Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
         2) Pneumatic plugs shall resist internal test pressure without requiring external bracing or blocking.
         3) All air used shall pass through a single control panel.
         4) Three individual hoses shall be used for the following connections.
         5) From the control panel to pneumatic plugs for inflation.
         6) From the control panel to the sealed line for introducing the low-pressure air.
         7) From the sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

3. Procedures
   a. All pneumatic plugs shall be seal-tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
   b. After a manhole to manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs have been checked by the above procedures, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any ground water that may be over the pipe. At least 2 minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected, the portion of the line being tested shall be termed "Acceptable" if that portion of the line does not lose air at a rate greater than 0.0015 cfm per square foot of internal pipe surface when tested at an average pressure of 3.0 psig greater than the back pressure. This back pressure is that which is exerted by ground water that may be over the invert of the pipe at the same time as of the test. The above requirements shall be accomplished by performing the test as follows:
   c. The minimum time required (in minutes for the pressure to decrease from 3.5 to 2.5 psig - greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time computed by the following equation:

      T = 0.0850(D)(K)/(Q), where T = time for pressure to drop 1.0 pounds per square inch gauge in seconds
      K = 0.00049DL, 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, assume 0.0015 ft3/min/sq ft internal surface

   d. In areas where ground water is known to exist, the Contractor shall install a 1/2-inch diameter capped pipe nipple approximately 10 inches long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Tests, the ground water shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the pipe nipple. The hose shall be held vertically and a measurement of the height (in feet) of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic tube. The height shall be divided by 2.3 feet to re-establish the pounds of pressure that will be added to all readings.

4. Results
   a. If the installation is determined unacceptable by the above test, the Contractor shall determine, at his own expense, the source of the leakage, he shall then repair or replace all defective materials and/or workmanship.

B. Manhole Testing
   1. Upon completion of installation, each manhole will be visually inspected to ensure the watertight integrity. All manholes on the project shall be vacuum tested in accordance with ASTM C 1244, latest edition, or otherwise tested in a manner preapproved by the Engineer. Manholes shall be tested for leakage separately and independently of the wastewater lines.
      a. In Wet Ground Conditions
         1) The ground shall be water-jetted around the manhole to ensure a positive

head of water; and that after completely saturating the earth surrounding the manhole, a visual inspection shall be made and the manhole shall be found to be bottle tight. If any seepage appears, the manhole will be deemed to have not passed the test. In Dry Ground Conditions

2) All wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one hour. For concrete manholes a wetting period of 24 hours may be used prior to testing in order to allow saturation of the concrete. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. Alternative test methods must ensure compliance with the above allowable leakage.

3) Should any manhole not pass this test, it shall be resealed and retested at the Contractor's expense until satisfactory test results have been achieved.

C. Hydrostatic Test for Force Mains

1. The Contractor shall provide all necessary equipment and shall perform all work required in connection with the tests. All pressure pipe installations shall be tested for leakage.
2. The test pressure shall be 1.5 times the maximum force main design pressure or 150 pounds per square inch gauge, whichever is greater. The test shall be held for a period of four (4) hours. The new system shall be tested in sections between valves. The length of test sections shall not exceed 2,000 feet unless authorized by the Engineer. Each test section shall be slowly filled with water, care taken to expel all air from the pipe. If necessary, the pipes shall be tapped at high points to vent the air. There will be no extra charge to the Owner for venting.
3. At the end of the test period, the amount of leakage shall be determined by the quantity of water that must be supplied into the pipe, or any valved section thereof, to maintain pressure within five pounds per square inch of the specified test pressure, after the air in the pipe has been expelled. The maximum allowable leakage shall be calculated using the following formula.

$L = (S)(D)(P^{0.5}) / 133{,}200$, where L = leakage in gal/hr
S = length of pipe in ft
D = inside diameter of pipe in inches
P = pressure in pounds per square inch

4. If the quantity of leakage exceeds the maximum amount calculated, the failed section will be rejected and not accepted until it meets the above requirements.

D. Deflection Test

1. The Contractor shall provide all necessary equipment and shall perform all required work to complete a deflection test on all gravity sanitary sewer lines installed.
2. Each sanitary sewer line is to be tested for deflection after the backfill has been in place for at least 30 days. The allowable deflection is not to exceed 5%; therefore, the mandrel, rigid ball, etc. used should be sized to 95% of the inside pipe diameter. The test shall be performed without mechanical pulling devices. Any lines with a deflection greater than the allowable are to be replaced.

END OF SECTION 33 33 13

SECTION 33 41 00 - STORM SEWERS AND APPURTENANCES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This section covers storm sewers, culverts, manholes, headwalls, inlets, junction boxes and miscellaneous items indicated in connection with the storm sewer system, complete. Excavation, trenching and backfilling are covered under SECTION 31 23 00 – CONSTRUCTION OF UNDERGROUND UTILITIES.

1.2 SUBMITTALS

A. Submit product data and shop drawings for ALL items to be installed.

B. Refer to Section 01 33 00 for submittal procedures.

1.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS FOR STRUCTURES

A. Precast Concrete Structures
   1. **Only precast concrete structures shall be installed**. Precast structures shall be traffic duty. Concrete for precast structures shall have a design strength of 4500 psi at 28 days. Precast structures shall be monolithic in design. Reinforcing steel shall be Grade 60 and shall meet ASTM A615.

      Fill inlet bottom with concrete and slope to ensure positive drainage from inlet to storm sewer line.

B. Mortar
   1. Mortar for pipe joints and connections to other drainage structures shall be composed of one part by volume of Portland Cement and two parts of sand. The Portland Cement shall conform to the requirements of Federal Specification SS-C-192, Type I or II. The sand shall conform to the requirements of AASHO Specification M-45. Hydrated lime may be added to the mixture of sand and cement in an amount equal to ten percent (10%) of the volume of cement used. Hydrated lime shall conform to the requirements of Federal Specification SS-L-351, or ASTM Specification C-141. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but shall in no case exceed six gallons of water per sack of cement. Water shall be clean and free of injurious acids, alkalies, and organic impurities. The mortar shall be used within thirty (30) minutes from the time the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar bead on the outside shall be protected for such period as is necessary

to obtain satisfactory curing.

C. Cast Iron

1. Cast iron shall conform to ASTM Standard Specification A 48, latest edition, for Class 20 gray cast iron. Cast iron shapes shall conform to the dimensions shown and shall be clean and perfect, free from sand or blow holes, or other defects. Castings shall be factory coated with asphaltum varnish. Twenty-three and one-half inch (23-1/2") manhole covers will be used for sewers forty-eight inches (48") diameter or less. Thirty-two-inch (32") manhole covers will be used for sewers in excess of forty-eight inches (48") in diameter.

D. Brick

1. **Brick structures shall only be used when specifically indicated on the drawings**. All structures shall be constructed, complete with covers in accordance with the details shown on the Drawings. Structures shall be constructed of solid precast segmental concrete masonry units or circular sections specially cast for use in manhole construction.

a. When Structures are to be constructed of brick, materials shall conform to the following:

Concrete:	As specified in the concrete specification.
Brick:	ASTM 662, Grade MW.
Segmental Concrete:	ASTM C139, except as modified herein. 1) Curing: Steam cured for at least 8 hours 2) Minimum Thickness: Upper 12 feet of manhole - 8 inches; Portion below 12 feet - 12 inches
Circular Precast Sections:	ASTM C478
Mortar:	1) Portland Cement - ASTM C150, Type II 2) Hydrated Lime - ASTM C207, Type S 3) Sand - Concrete Sand (fine aggregate which has been sieved through an 8-mesh screen 4) Volumetric Proportions - 1-part Portland Cement, 1/2-part hydrated lime, 3 parts sand 5) Mixing - Cement, lime, and sand shall be thoroughly mixed dry and only enough water added to form a mortar of the proper consistency.
Castings:	1) Iron - ASTM A 48 2) Coating - Hot asphaltum varnish applied at the foundry.

2.2 PIPE FOR CULVERTS AND STORM DRAINS

A. Pipe for storm drains and culverts shall be reinforced concrete pipe (RCP), ASTM C 76, Class III, unless otherwise indicated. Where HDPE (High-Density Polyethylene) is specified, the joints shall

meet ASTM F477 and ASTM D3212 (watertight joints). All pipes shall have a smooth interior.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. All concrete segmental units shall be saturated with water before laying and shall be damp but free from surface water when laid.

B. All mortar shall be used within 30 minutes after mixing. Mortar which has begun to be taken on initial set, shall be discarded and shall not be mixed with additional cement or new mortar. All segmented concrete manholes shall be plastered on all outside surfaces and three feet (3') above the invert on all inside surfaces with mortar not less than one-half inch (1/2") thick. Manhole inverts shall be carefully constructed to maintain the proper velocities through the manhole with no increase in the velocity in the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be connected with as large radius of curve as practicable. All inverts shall be troweled to smooth clean surface. Concrete filling between the sewer invert and walls of manholes shall be flush with top edges of the inverts and slope up from the invert at the rate of two inches (2") per foot. Circular precast sections shall be provided with a mastic gasket to seal the joints between sections. After the sections are in place, the outside of each joint shall be plastered with cement mortar.

C. Piping shall be constructed of the materials specified in this section, and in the manner indicated on the Drawings. Pipe shall be laid true to the grades shown on the Drawings. Any line in which opening or faulting of the joints occurs during backfill or before final inspection and acceptance, such that infiltration of material or a change in flow characteristics results, must be repaired or replaced to the satisfaction of the Engineer. Under no circumstances shall pipe be laid on unsuitable soft material, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Full responsibility for the diversion of drainage and dewatering of trenches during construction shall be borne by the Contractor. Any section of the pipe already laid that is found to be defective or damaged shall be taken up and re-laid or replaced as directed by the Engineer immediately, without additional cost to the Owner.

3.2 INSTALLATION OF CONCRETE PIPE AND PRECAST CONCRETE BOX CULVERT

A. Laying Pipe

1. The laying of pipes on the prepared foundation shall be started at the outlet and with the spigot or tongue ends pointing in the direction of flow and shall proceed toward the inlet end with the abutting sections properly matched, true to the established lines and grades. The Contractor shall furnish and place in position all the necessary batter boards for controlling the work. The batter boards shall be of sufficient size timber and shall be substantially supported. The boards and all location stakes must be properly maintained in place. The Contractor shall also furnish, at his own expense, good sound twilled lines for use in giving lines and grades and necessary plummets and graduated poles of an approved form.

2. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trenches without disturbing the prepared foundation and the sides of the trench. The ends of the pipe shall be carefully cleaned before the pipes are placed. As each length of pipe is laid, the mouth of the pipe shall be protected to prevent the entrance of earth or bedding material. The pipes shall be fitted and matched so that when laid in the bed they shall form a smooth, uniform conduit. Shape trench bottom and perform excavation as specified under SECTION 31 23 00 – CONSTRUCTION OF UNDERGROUND UTILITIES. Shore and sheet as specified in SECTION 02150 - TRENCH

SAFETY per Plans, and referenced documents.

B. Joints in Concrete Pipe
   1. Unless otherwise specified, joints in reinforced and unreinforced concrete pipe, shall either be neoprene or rubber gasket joints as hereinafter described. Cold compound joints shall only be allowed when specifically noted in the specifications or contract drawings.

C. Neoprene or Rubber Gasket Joints
   1. Joints made with neoprene, rubber, or other similar material that has been approved by the Engineer will be acceptable for use with reinforced or non-reinforced concrete pipe, either tongue and groove or bell and spigot. The ends of the pipe must be accurately made and designed for use with the gaskets. The type of joint and the gasket must have the approval of the Engineer and may be submitted to the Engineer for approval prior to submitting bids for work on which its use is intended. The joint material and workmanship shall be such as to provide a watertight joint. Joints shall, unless otherwise specified, be pointed on the outside with cement mortar.

D. Bell and Spigot Pipe – Cold Compound Joints
   1. The inside of the pipe bells and the outside of the spigot ends shall, while dry, be completely coated with joint primer. This coating shall be applied sufficiently in advance so that the primer will be thoroughly dry when the pipe is laid. Pipe twenty-four inches (24") and larger shall be primed at the point of manufacture. Apply a fillet of compound on the bottom half of the inside of the bell, press enough dry twisted jute into the compound to pass around the pipe and lap at the top and shove home the spigot of the pipe. Bring the jute around the pipe, firmly caulk into place. The jute should be sufficient to fill one-fourth (1/4) the depth of the bell. Fill the remaining three-fourths (3/4) of the depth of the bell with compound, taking care to leave no voids and provide sufficient compound to form a fillet sloping forty-five degrees from the outer end of the bell to the barrel of the next pipe.
   2. Compound used for these joints shall be a well-known brand of material of proven worth, uniform in consistency and approved by the Engineer as being equal to RAM-NECK. Primer shall be of the type recommended by the manufacturer of the compound used.

E. Tongue and Groove Pipe – Cold Compound Joints
   1. Unless otherwise specified, this type of joint shall be used for tongue and groove pipe joints not made with approved neoprene or rubber gaskets. The compound and primer shall be the same as described herein for use with bell and spigot pipe.
   2. Both ends of the pipe shall, while clean and dry, be coated with primer on all surfaces that will be in contact with the compound. The primer shall be allowed to dry before the pipe is laid. Twenty-four inches (24") and larger pipe shall be primed at the factory.
   3. After pipe has been set to proper line and grade in the trench a one-half (1/2") thick layer of the compound shall be troweled or otherwise placed on the groove end of the pipe covering about two-thirds (2/3) of the joint face around the entire circumference. Next the tongue end of the next pipe shall be shoved home with sufficient pressure to make a tight joint. Care shall be taken to avoid leaving ridges of the compound projecting into the pipe in a manner that would obstruct the flow. The Contractor will make the necessary adjustment in the quality and consistency of the compound as the work progresses.
   4. An outside band of the joint compound shall be installed completely around the circumference of the pipe at the joint. This will necessitate digging "bell holes" at each joint. The band shall have a thickness at the center of at least three-quarter inch (3/4) tapering uniformly to nothing approximately three inches (3") each side of the center. Where Class A bedding is used, the band may be omitted on portions of the joint that will be embedded in the cement-stabilized sand bedding.

F. Corrugated Steel Pipe
   1. Fully bituminous coated corrugated steel pipe shall conform to FS WWP 405, Class I or II,

Shape 1, 2, 3, with Coating A. Gauge of pipe shall be as indicated on the Drawings.

2. The space between pipe and connecting bands shall be kept free of dirt and grit so that corrugations fit snugly. Connecting band shall be tapped with soft head mallet of wood, rubber or plastic while being tightened to take up slack and insure tight joint. Fill annular space between abutting sections of fully paved pipe and pipe arch with bituminous material after jointing.
3. Unless otherwise specified, field joints shall be made with outside bands, each consisting of one or two pieces. Type, size, and gauge of band and size of angles and bolts shall be as indicated on the Drawings or as applicable for gauge and type of pipe used.

3.3 INSTALLATION OF HDPE PIPE

A. HDPE Drainpipe shall be high-density corrugated polyethylene heavy-duty pipe and shall be manufactured in conformance with the latest AASHTO specifications of M294 Type S and AASHTO M252. (ADS N12 or equivalent are acceptable materials)

B. Joints and Fittings: Pipe and fittings shall conform to AASHTO M294 and AASHTO M252. Couplers shall cover not less than one full corrugation on each annular section of pipe.

C. Bedding Material: Bedding material shall be cement-stabilized sand unless otherwise noted in the plans. **Refer to Specification 31 23 23.16 – Cement Stablized Sand Bedding and Backfill.**

3.4 MANHOLES

A. Installation
1. Manhole installation shall be in strict compliance with the manufacturer's recommended installation procedures.
2. Excavation shall be adequate to accommodate the concrete foundation slab and to provide working room around the manhole.

B. Stubs
1. Stubs shall be provided in manholes at the locations shown on the Plans. Stubs shall be not less than 2.0 feet long and shall terminate in a bell and plug.

C. Backfilling
1. Backfilling around manholes shall not begin until concrete base has cured for twenty-four (24) hours. Backfill using native soil free of foreign objects, stones, concrete, or debris. Backfill in layers not to exceed twelve inches (12") to avoid uneven loading. Do not allow equipment to impact manholes during backfill operations.
2. Do not backfill above flat areas at top of cone of manholes to allow for installation of concrete chimney.

D. Finishing Manhole to Grade
1. Construct chimneys using precast concrete rings to bring manholes to finish grade.
2. Seal both the top and the bottom faces of concrete rings with “RAM-NEK” rope type mastic sealant.

E. Manhole Frames and Covers
1. Cast iron for manhole frames and covers shall conform to the dimensions shown on detail drawings and shall be clean, free from sand and blow holes or other defects. Manhole covers and Inlet Grates shall include all graphics, logos, and verbiage required by all regulatory agencies having jurisdiction over the project. Holes in cover must be free from plugs or burrs. Bearing surfaces of frames and covers are to be machined so that even bearing occurs when covers are seated in the frame.

2. Provide slotted type cast iron grates for inlets with openings approximately 1- 5/16”x6- 5/8”

and similar in design to Model V5630 by East Jordon Iron Works or GPISD-approved alternate.

3. Gratings, Covers and Frames: Cast iron, McKinley, Neenah or approved equivalent. All grates in ADA Accessible Route shall be ADA compliant.

END OF SECTION 33 41 00

SECTION 33 41 11 CLOSED CIRCUIT TELEVISION INSPECTION OF SANITARY SEWERS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Item shall govern for furnishing all materials, labor, and equipment necessary for the cleaning and inspection of the existing and constructed storm sewer lines or systems indicated on the drawings.

B. Inspection shall be by means of a closed-circuit television inspection; and be documented in a written report, including electronic copies of the televised inspection.

1.2 DEFINITIONS

A. Stationing - The term denoting longitudinal measurement in linear feet. For example, Manhole No.1 is at Sta. 0+50, and Manhole No.2 is at Sta. 5+01.

Manhole Section - The term "manhole section" as used in these Standard Specifications shall mean the length of pipe and/or box culverts connecting manholes and/or junction boxes.

Lateral Pipe and/or Lead Pipe – the pipe connecting an inlet to a manhole and/or a junction box.
Outfall Pipe – a section of pipe run from a manhole or junction box to an outfall ditch.

1.3 CONTRACTOR OBLIGATIONS

A. The Contractor shall furnish at no cost to the television crew, the following items during the entire project:

a. Site Access. Access to the site of work with sufficient area for the placement of the equipment and personnel. All work will be within easements and roadway rights-of-way.

b. Drawings. A set of drawings indicating the location of the storm sewer system to be inspected, along with identification of the manholes, junction boxes, inlets, outfalls and all pipe and/or box culvert runs.

c. Prior to beginning the televising of the storm sewer system, a signboard shall be filmed showing the name of the project, the date, and time filming begins.

PART 2 – CLEANING AND CLOSED-CIRCUIT TELEVISION (CCTV) INSPECTION

2.1 EQUIPMENT AND PROCEDURES

A. A self-contained and air-conditioned mobile trailer or van shall be provided which is large enough to accommodate representatives of the Engineer and the Contractor for purpose of viewing/monitoring the work while inspection is in progress. Trailer or van shall be equipped with a closed circuit television camera, color monitor, video tape recorder and/or DVDR, winches (power and mechanical), cable, and cable reel, suitable metering device so that exact location of camera within the line being televised can be noted at all times, and all necessary equipment for successful completion of television inspection, recorded on technicolor video.

B. Perform cleaning prior to performing closed circuit television inspection. Cleaning shall include utilizing variable water pressure nozzles, up to 3,000 psi. The CCTV Contractor shall remove, collect, transport, and dispose of sand, debris, and liquid wastes to legal disposal sites.

C. Hydraulically Propelled Equipment: The equipment used shall be of a movable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the pipe being cleaned and shall provide a flexible scraper around the outer periphery to insure removal of grease. If sewer cleaning balls or other equipment which cannot be collapsed is used, special precautions to prevent flooding of the sewers and public or private property shall be taken.

D. High-Velocity Jet (Hydrocleaning) Equipment: All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel. The NASSCO Jetter Code of Practice shall be consulted as a guide for the selection of different type nozzles and recommended pressure applications for various cleaning requirements.

E. Mechanically Powered Equipment: Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be allowed. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of 750 feet of rod. The rod shall be specifically heat treated steel. To insure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.

F. Large Diameter Cleaning: For cleaning large diameter sewer, storm or combination pipes, consideration should be given to a combination hydraulic high volume water and solids separation system. The flow from the sewer will provide water for the pump operation so no potable water is necessary and treatment costs are not a factor. Water volume of up of 15 GPM at 2000 PSI+ will move solids to the downstream manhole in high flow conditions. The separation system will dewater solids to 95% (passing a paint filter test) and transfer them to a dump truck for transport to a sewage treatment plant or approved landfill. Sewer water will be filtered to a point where it can be used in the pump for continuous cleaning. No by-passing of sewer flows will be necessary. The unit shall be capable of 24 hour operation and the unit shall not leave the manhole until a section is fully cleaned.

G. During sewer cleaning operations, satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. When possible, the flow of sewage in the sewer shall be utilized to provide the necessary pressure for hydraulic cleaning devices. When additional water from fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant.

H. The designated sewer manhole sections shall be cleaned using hydraulically propelled, high-velocity jet, or mechanically powered equipment. Selection of the equipment used shall be based on the conditions of lines at the time the work commences. The equipment and methods selected shall be satisfactory to the Owner’s Representative. The equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes.

If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire manhole section, it will be assumed that a major blockage exists and the cleaning effort shall be abandoned.

I. Should a water level be encountered that would prevent the viewing of the storm sewer interior, the Contractor shall dewater the segment to allow for inspection. In the case where there is constant water infiltration due to an adjacent pipe or box culvert break, the Contractor shall notify the utility operator.

J. Television equipment shall consist of a tilt and pan color camera and a monitoring unit connected by a coaxial cable. Camera shall be small enough to ensure passage through the lines, be waterproof and provide a continuous, clear picture showing the entire inside periphery of the pipe or box culvert. The Contractor shall provide suitable lighting system to allow all features and condition of the pipe or box culvert to be clearly visible on the colored videos.

K. The television inspection shall be performed on one manhole section at a time. Each manhole section being inspected shall be isolated from the remainder of the line by the use of a line plug to insure total viewing of the inside periphery of the pipe or box culvert. The inspection shall be performed by pulling the television camera through the line along the axis of the pipe or box culvert. A crawler type tractor for the camera is also acceptable. The inspection shall be performed in a forward and/or backward direction, according to line conditions at the time the inspection is made.

L. During the television inspection operation an inspection record shall be kept which will show clearly the exact location, in relation to the centerline of the adjacent manhole, of each defect, crack, gap, or separation discovered by the television. To ensure accurate measurement, the measurement shall be made from an object at a fixed distance in front of the television camera, being positioned at the exact location of the defect, crack, separation of pipe or box culvert failure. The measurement reading shall be made at ground level by means of a meter device

2.2 RECORDS

A. A record shall be kept of the locations of defects located in the storm sewer using the distance from the nearest manhole or junction box so that the defects can be easily re-located.

B. Contractor shall furnish a minimum 2 complete recorded/televised, narrated, record of all lines televised (2 USB Flash Drives). All recorded media shall have a continuous audio recording that reflects footage during the televising operations. At the completion of each recording, the televised media become the property of the Owner. All costs incurred in connection with the television operation are to be included as a lump sum bid price for this televising and recording. The USB Flash Drive package shall be labeled with the following:
   a. Contractor's name …
   b. Inspection Type- "Post Installation"
   c. Date of Inspection
   d. Project name
   e. Total number of USB Flash Drives
   f. Date Submitted

C. Following the CCTV inspection, the Contractor shall provide 2 copies of the bound written report indicating the physical location of the storm sewer elements, with a map that illustrates the relationship between the televised footage and above ground location between manholes and/or junction boxes, size of lines, pipe or box culvert materials used, location of deficiencies observed, and depth of flow line relative to the natural grade.

PART 3 – MEASUREMENT AND PAYMENT

A. No separate payment shall be made for materials furnished or work performed under this Section. Include the cost of same in the contract price bid for work of which this is a component part.

END OF SECTION 33 41 11

SECTION 33 44 19 - STORM WATER MANAGEMENT

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 STORM WATER MANAGEMENT

A. "Storm Water Management" shall consist of all requirements to comply with current Texas Commission on Environmental Quality (TCEQ) Texas Pollutant Discharge Elimination System (TPDES) Construction Storm Water Discharge Regulations and Requirements.

1.2 SCOPE

A. The scope of this item includes satisfying the TPDES Permit Regulation including, but not limited to, any permits that shall be obtained and any construction practices, equipment, materials, labor, and structures necessary to conform with these regulations.

1.3 STANDARDS

A. This section will be governed by the regulations of the city and or county have jurisdiction over the project.

B. All provisions, technical specifications, guidelines, intent and construction practices detailed within this handbook will be considered a part of the technical specification and will have full force and effect regarding this project.

1.4 PERMITS

A. The Contractor is responsible for the planning and implementation procedures for storm water pollution prevention plans (SWPPP) for this construction site. The SWPPP shall be fully developed and implemented before submitting a Notice of Intent (NOI) that this project will be covered by the final TPDES general permit requirements.

B. The Contractor shall file the NOI with the TCEQ at least seven (7) days prior to the commencement of construction activities.

C. The Contractor shall also prepare and submit inspection reports pertaining to the Storm Water Management for the City and file the Notice of Termination after the site has been stabilized.

1.5 PAYMENT

A. Storm Water Management will be incidental to all other Bid Items in the bid proposal.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 CONSTRUCTION

A. The Contractor is responsible for all construction activities, structures, etc., associated with implementing the TPDES Permit and the SWPPP. This includes, but is not limited to, filter fabric fences, straw bale fences, temporary hydro-mulch seeding, sodding, inlet protection barriers, etc. that pertain to the intent of this section.

END OF SECTION 33 44 19